PROJECT MANUAL FOR

Hyde Park Elementary School



Project Location:
333 East 300 North
Hyde Park, Utah 84318

CACHE COUNTY
SCHOOL DISTRICT

Cache County School District
84 East 2400 North
North Logan, Utah 84341

Conformed Project Manual

April 22, 2025

naylor wentworth lund
architects

SECTION 00 0002

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DWA CONSTRUCTION INC.

WAIVER AND RELEASE UPON FINAL PAYMENT

Property Name: New Hyde Park Elementary School

Property Location: 333 East 300 North; Hyde Park, Utah 84318

Undersigned's Customer: _____

Invoice/Payment Application Number: _____

Payment Amount: _____

To the extent provided below, this document becomes effective to release and the undersigned is considered to waive any notice of lien or right under Utah Code Ann., Title 38, Chapter 1, Mechanics' Liens, or any bond right under Utah Code Ann., Title 14, Contractors Bonds, or Section 63-56-504 related to payment rights the undersigned has on the above-described Property once:

1. **the undersigned endorses a check in the above referenced Payment Amount payable to the undersigned; and**
2. **the check is paid by the depository institution on which it is drawn.**

This waiver and release applies to the final payment for the work, materials, equipment, or a combination of work, materials, and equipment furnished by the undersigned to the Property or to the Undersigned's Customer.

The undersigned warrants that the undersigned either has already paid or will use the money the undersigned receives from the final payment promptly to pay in full all the undersigned's laborers, subcontractors, materialmen, and supplie for all work, materials, equipment, or combination of work, materials, and equipment that are the subject of this waiver and release.

Dated: _____

_____

(Company Name)

By: _____

Its: _____

P.O. Box 3448
Logan, Utah 84323-3448

www.dwaconstruct.com

Phone: (435)752-6860
Fax: (435)752-7606

CONSTRUCTION INC.

PAYMENT REQUEST FORM

Project Name: NEW HYDE PARK ELEMENTARY SCHOOL

Invoice/Payment Application Number: _____ **Period Ending Date:** _____

STATEMENT OF CONTRACT AMOUNT:

1.	Original Contract Amount	$_____
2.	Approved Change Orders	$_____
3.	Adjusted Contract Amount *(Add or Subtract line 2 from line 1)*	$_____

PROGRESS BILLING:

4.	Work Completed and Materials Provided on Contract to Date (____% to date)	$_____
5.	Less Retention (5% to date)	$_____
6.	Total Work Completed and Materials Provided Less Retention *(Subtract line 5 from line 4)*	$_____
7.	Total Previous Application for Payments *(Line 6 from previous application)*	$_____
8.	**AMOUNT DUE THIS REQUEST** *(Subtract line 7 from line 6)*	$_____

LABOR & MATERIALS SUPPLIED THIS MONTH:

9.	Materials supplied this month	$_____
10.	Labor this month	$_____

Supplier/Subcontractor Lien Releases (DWA provided forms) must be provided prior to distribution of payments.
Waiver & Releases attached to this payment request form? (circle one). *Yes No*
Name and Amount of Two-Party Checks required on this months draw: _____

_____

Company Name: _____
DWA Utah Conditional Waiver & Release Upon Progress Payment must be attached to this request.

By: _____
(Signature Here)

Print Name: _____
Title: _____
Date: _____

P.O. Box 3448
Logan, Utah 84323-3448

www.dwaconstruct.com

Phone: (435)752-6860
Fax: (435)752-7606

DWA CONSTRUCTION INC.

CONDITIONAL WAIVER AND RELEASE UPON PROGRESS PAYMENT

Property Name: New Hyde Park Elementary School

Property Location: 333 East 300 North; Hyde Park, Utah 84318

Undersigned's Customer: _____

Invoice/Payment Application Number: _____

Payment Amount: _____

Payment Period: _____

To the extent provided below, this document becomes effective to release and the undersigned is considered to waive any notice of lien or right under Utah Code Ann., Title 38, Chapter 1, Mechanics' Liens, or any bond right under Utah Code Ann., Title 14, Contractors Bonds, or Section 63-56-504 related to payment rights the undersigned has on the above described Property once:

1. **the undersigned endorses a check in the above referenced Payment Amount payable to the undersigned; and**
2. **the check is paid by the depository institution on which it is drawn.**

This waiver and release applies to a progress payment for the work, materials, equipment, or a combination of work, materials, and equipment furnished by the undersigned to the Property or to the Undersigned's Customer which are the subject of the invoice or Payment Application, but only to the extent of the Payment Amount.

This waiver and release does not apply to any retention withheld; any items, modifications, or changes pending approval; disputed items and claims; or items furnished or invoiced after the Payment Period.

The undersigned warrants that the undersigned either has already paid or will use the money the undersigned receives from this progress payment promptly to pay in full all the undersigned's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or combination of work, materials, and equipment that are the subject of this waiver and release.

Dated: _____

_____

(Company Name)

By: _____

Its: _____

P.O. Box 3448
Logan, Utah 84323-3448

www.dwaconstruct.com

Phone: (435)752-6860
Fax: (435)752-7606

CONSTRUCTION INC.
P.O. Box 3448 Logan, Utah 84323-3448

Purchase Order Agreement

This agreement made at Logan, State of Utah, on the 5th day of May, 2025 by and between **DWA CONSTRUCTION, INC.** P.O. BOX 3448 LOGAN, UT 84323-3448 PHONE:(435)752-6860 FAX:(435)752-7606 hereinafter referred to as the prime Contractor and **SUPPLIER NAME; STREET ADDRESS; CITY, STATE ZIP CODE; PHONE(000)000-0000 FAX: N/A,** hereinafter referred to as the Supplier.

The Supplier shall furnish all materials, fabrication labor and shop drawings required for section.

DESCRIPTION OF SECTION, FOB TO JOBSITE AS PER PLANS AND SPECIFICATIONS.

TOTAL CONTRACT AMOUNT: $0,000.00

This project is tax exempt. Addendum 00 acknowledged & included in price. Project completion 07-31-26

The construction project identified as CCSD HYDE PARK ELEMENTARY, located at 333 EAST 300 NORTH, State of UTAH, as shown in the plans and specifications pertaining to the above, named project and any other agreements made between the General Contractor and Supplier. The General Contractor and Architect shall have final approval of the design of the furnished items.

All materials shall be delivered F.O.B. jobsite by Supplier for the total purchase order price of ***Zero thousand zero hundred dollars and 00 cents,*** $***0,000.00***.

Supplier shall be liable for all payroll taxes and related employee costs with respect to employees employed by same and shall furnish proof of worker's compensation insurance and liability insurance if requested by Prime Contractor.

_____
DWA CONSTRUCTION, INC.

_____
SUPPLIER NAME

SUBCONTRACT AGREEMENT

THIS SUBCONTRACT AGREEMENT (hereinafter Agreement), made at Logan, Utah, this 5th day of MAY, 2025, by and between DWA CONSTRUCTION, INC., P.O. Box 3448, Logan, Utah 84323, hereinafter referred to as DWA, and SUBCONTRACTOR NAME; STREET ADDRESS; CITY, STATE, ZIP CODE; PHONE(000)000-0000 FAX: N/A, hereinafter referred to as the Subcontractor. DWA and Subcontractor agree as follows:

1. SCOPE OF WORK

a. The Project
CCSD HYDE PARK ELEMENTARY SCHOOL
333 EAST 300 NORTH
HYDE PARK, UTAH 84318

b. The work to be performed by the Subcontractor under the terms of this Agreement consists of completing the Work (as hereinafter defined) in a manner that all components will work as intended, and furnishing, without limitation, all labor, material, supplies, tools, implements, equipment, scaffolding, permits, fees, warranties, bonds, and taxes to complete all of the following in strict accordance with all applicable drawings, plans, specifications, and contract documents:
SECTION OR DIVISION NUMBER 00 0000 – DESCRIPTION OF SCOPE OF WORK; FURNISHED AND INSTALLED COMPLETE PER PLANS AND SPECIFICATIONS

ADDENDUMS 00 ACKNOWLEDGED PROJECT COMPLETION DATE: 07-31-26

(All items to be performed by Subcontractor as described in sections 1.b., 1.c. and 1.d. are hereafter referenced as the "Work").

Base Bid:	$ 0,000.00
Alternates:	$
	$
TOTAL AMOUNT:	**$ 0,000.00**

PROJECT IS EXEMPT FROM UTAH SALES TAX

c. Work per Contract. The Work shall be performed and completed in strict accordance with (1) the complete plans and specifications (hereinafter, the "Plans and Specifications"), as prepared by NAYLOR WENTWORTH LUND ARCHITECTS(hereinafter, "Architect") for CACHE COUNTY SCHOOL DISTRICT (hereinafter, "Owner"); (2) DWA's prime contract with Owner; and (3) all documents referenced in DWA's prime contract with the Owner, including, without limitation, the Plans and Specifications and all addenda or authorized changes issued prior to the date of execution of this Agreement (hereafter collectively, the "Contract"). Subcontractor acknowledges receipt of a complete copy of the the Contract. No delineation of duties of the Subcontractor in this Agreement shall be utilized to avoid requirements of the Contract, including the Plans and Specifications, for the Work of Subcontractor.

d. Work Standard. All Work to be performed as set forth herein above shall be complete and shall be accomplished in accordance with the Plans and Specifications, the Contract, addenda, shop drawings, and Architect's directions. All Work shall be done in a workmanlike manner, shall be acceptable to DWA, and shall comply in every detail to the Owner's Plans and Specifications. In the event of any doubt or question arising between DWA and Subcontractor with respect to the Work, the decision of the Architect shall be conclusive and binding.

e. No Architect. Should there be no supervising architect over the Work, then the matter in question shall be determined as provided in Section 11 of this Agreement.

f. Submittals. Within 30 days after it signs this Agreement, Subcontractor shall issue by mail or email all required submittals to DWA, together with detailed information as to how the submittals comply with the Contract. No submittal shall be deemed accepted until signed in writing by DWA, and acceptance by DWA does not change or waive the requirement for Subcontractor to comply with the Contract, Plans and Specifications and other documents for which Subcontractor remains responsible. Any rejected submittal shall be corrected and replaced by Subcontractor within seven (7) calendar days of notice of the rejection.

2. PAYMENTS

a. Requests for Payment. DWA agrees to pay to the Subcontractor for the satisfactory completion of the Work the sum of Zero thousand Zero hundred dollars and 00 cents******** ($0,000.00) in monthly payments of 95% of the Work performed in any preceding month, in accordance with the Request for Payment prepared by the Subcontractor and as approved by DWA and Architect, such payments to be made only as payments are received by DWA from the Owner covering the approved portion of the Subcontractor's monthly Request for Payment ("Draws"). Receipt of payment by DWA from Owner is an absolute condition precedent to any payment to Subcontractor, and payment to Subcontractor will only be made after DWA receives payment from the Owner. DWA may in its discretion make payments in the name of Subcontractor or by joint check to any employee, supplier, or subcontractors of Subcontractor (hereinafter collectively "Subs") who have furnished materials or labor to said Subcontractor as part of the Work. Subcontractor shall credit the amounts of such payments against any amounts that DWA owes or allegedly owes to Subcontractor. Subcontractor agrees to use the attached Request for Payment (Exhibit A) in all submittals for payment, and with each submittal for payment to deliver a fully executed Lien Waiver (Exhibit B for progress payments and Exhibit C for Final Payment) for the Work completed to date in accordance with the Contract, including but not limited to Lien Waivers from all material suppliers and Subs, at all tiers. DWA may modify the form of the Request for Payment and Lien Waivers as needed in its sole discretion.

b. Documentation and Verification. DWA shall have the right to request underlying documentation to support any Request for Payment submitted by Subcontractor to DWA. Upon such request, Subcontractor shall provide the underlying documents that justify the costs set forth in the Request for Payment. DWA also has the right, and Subcontractor hereby authorizes DWA, to communicate with any Subs, suppliers and employees regarding the status of Subcontractor's accounts with respect to the Work, and Subcontractor authorizes all Subs, suppliers and employees to disclose the requested information to DWA.

c. Timing. Draw requests must be submitted and received by DWA by the 25th of each month. Payment to the Subcontractor will be made for completed, acceptable Work no later than thirty (30) days after the corresponding payment has been received by DWA from Owner.

d. No Request for Payment. In the event the Subcontractor does not submit to DWA such Request for Payment prior to the date of submission of DWA's monthly Draw to Owner, then DWA may include in its monthly Draw to the Owner for work performed during the preceding month such amount as it shall deem proper for the Work of the Subcontractor for the preceding month, and the Subcontractor agrees to accept such approved portion thereof as its regular monthly payment, as described above, subject to all other terms of this Agreement.

e. Fiduciary Duty. The Subcontractor agrees that any funds received for the performance of the Work under this Agreement shall be used exclusively for labor, materials, and equipment furnished as part of the Work, that the Subcontractor has a fiduciary responsibility with respect to these funds, and that these funds will not be diverted to satisfy obligations the Subcontractor may have under any other contracts, debts, liabilities or obligations unrelated to the Work.

f. Withheld/Offset Payments. DWA may withhold a monthly payment and/or final payment to such extent as may be necessary in the exercise of DWA's discretion to protect DWA from loss for which the Subcontractor is responsible, including but not limited to, loss resulting from defective Work or untimely Work, third party claims, failure of Subcontractor to pay employees or suppliers, incomplete Requests for Payment, failure to submit required documentation, or the filing of any payment bond claim, mechanics lien, lis pendens or related claims. If Subcontractor has unfulfilled obligations to DWA on other projects, DWA may exercise a right of offset of sums from other projects due to DWA from Subcontractor against any payment due Subcontractor for the Work.

g. Extra Work. If Subcontractor performs extra work or changes to the Work without receiving a written Change Order prior to the execution of such Work, DWA shall be under no obligation to compensate the Subcontractor for such work.

h. Final Payment and Warranty. Before final payment is made, the Subcontractor agrees to execute to DWA and/or the Owner a written final lien waiver (together with final lien waivers from all material suppliers and Subs) and/or lien releases, if necessary, and a written guarantee for its Work, agreeing to make good without cost to the Owner or DWA any and all defects due to imperfect workmanship and/or materials which may appear within the period so established in the Contract; and if no such period be stipulated in the Contract, then such guarantee shall be executed for a period of one year from date the Owner accepts the Work. The Subcontractor further agrees to execute any special guarantees as provided by the terms of the Contract, prior to final payment. DWA's payment of any sums to Subcontractor shall not constitute a waiver of any claims DWA may have against Subcontractor.

3. PROSECUTION OF WORK, DELAYS, ETC.

a. Time Is of the Essence and Conflicting Terms. DWA and the Subcontractor agree to be bound by the terms of the Contract, construction regulations, general conditions, Plans and Specifications, and any and all other contract documents, if any there be, insofar as applicable to this Agreement, and to that portion of the Work herein described to be performed by the Subcontractor. If conflicting requirements of Subcontractor exist in the Contract and this Agreement or otherwise, Subcontractor shall be bound to do the additional, greater or more costly requirements as part of the Work.

b. Schedule. DWA shall establish the Work Schedule ("Schedule") within the first month after signing this Agreement, which Schedule may be reasonably modified and refined by DWA, which shall give notice of the same to the Subcontractor. DWA is the owner of the Schedule and of all float and slack time within the Schedule.

c. Commencement. Commencement of the Work by Subcontractor is an expression by the Subcontractor that:

(1) This Agreement has been accepted in its entirety.

(2) The Subcontractor has fully reviewed and analyzed all of the Plans and Specifications, this Agreement and the Contract, and the Total Amount in paragraph 1.b. is fair, just and complete compensation for the Work.

(3) The Subcontractor is aware of any impact or interference which the site, site conditions, climate, construction sequence, and the work of other Subcontractors will have upon access, operations, efficiency, and related factors of the Work to be performed by the Subcontractor; and

(4) It is the Subcontractor's responsibility to identify any non-code compliant construction details, omissions and discrepancies with respect to the Work, and none have been identified.

d. Due Diligence. The Subcontractor shall prosecute its Work with due diligence so as not to delay the completion of the Project and the work of DWA or other subcontractors. In the event that the Subcontractor neglects and/or fails to supply the necessary labor and/or materials, tools, implements, equipment, etc., in the opinion of DWA to timely complete the Work or to complete the Work in accordance with the Contract, then DWA shall notify the Subcontractor in writing setting forth the deficiency and/or delinquency; and within three (3) business days after date of such written notice, if the Subcontractor fails to correct the Work or to commence and continue correction of such default or neglect with diligence and promptness, DWA shall have the right if DWA so desires to take over the Work of the Subcontractor in full, and exclude the Subcontractor from any further participation in the Work covered by this Agreement; or at DWA's option, DWA may take over such portion of the Subcontractor's Work as DWA shall deem to be in the best interest of DWA, and permit the Subcontractor to continue with the remaining portions of the Work.

e. Replacement and Costs. Whichever method DWA might elect to pursue in the preceding paragraph, in addition to any and all other remedies in this Agreement, in law and in equity, the Subcontractor agrees to release DWA, for its use only, without recourse, any materials, tools, implements, equipment, etc., on the site, belonging to or in the possession of the Subcontractor, for the benefit of DWA, in correcting or completing the Work covered in this Agreement; and DWA agrees to correct or complete the Work to best of DWA's ability and in the most economical manner available to DWA at the time. Any costs incurred by DWA in doing any such portion of the Work covered by this Agreement shall be charged against any monies due or to become due under the terms of this Agreement; and in the event the total amount due or to become due under the terms of this Agreement shall be insufficient to cover the costs accrued by DWA in completing the Work, the Subcontractor and its sureties, if any, shall be bound and liable to DWA for the difference.

f. Delays. If Subcontractor believes any delays in the Schedule are required through no fault of the Subcontractor, within seven (7) days after the event giving rise to the delay, Subcontractor must submit a written change order to DWA, specifying and detailing any basis for increased costs; and upon failure to timely submit, Subcontractor waives any right to submit or have approved the change order.

g. Delay Liability. The Subcontractor shall not be held liable for any delays arising out of acts of God, strikes, embargoes, or other causes explicitly determined by DWA to be beyond the control of the Subcontractor. Subcontractor will be responsible for liquidated damages of $1,000.00 per day for any delay to DWA or any other subcontractors which may be directly attributable to Subcontractor; and provided, further, that if the Subcontractor fails to meet the Schedule as determined by DWA and as it may reasonably be amended from time to time by DWA under this Agreement, DWA may withhold from the contract price due the Subcontractor under this Agreement an amount equal to $1,000.00 per day times the number of days after the Schedule until that portion of the Work is completed, and in such event shall apply said sum against all sums owing from DWA to Subcontractor, and Subcontractor agrees to pay any deficiency on demand. All delay charges will be deducted from the amount due Subcontractor.

h. Defects. Should the proper and accurate performance of any Work under this Agreement depend wholly or partially upon the proper workmanlike or accurate performance of any work or materials furnished by DWA or of other subcontractors on the Project, the Subcontractor agrees to use all means necessary to discover any such defects and report the same in writing to DWA before proceeding with the Work which is so dependent, and Subcontractor shall allow DWA a reasonable amount of time in which to remedy such defects; and in the event Subcontractor does not so report to DWA in writing, then it shall be assumed that the Subcontractor has fully accepted the work of others as being satisfactory, and Subcontractor shall be fully responsible thereafter for the satisfactory performance of the Work covered by this Agreement, regardless of the defective work of others.

i. Clean-up. Subcontractor will be responsible for clean-up, removal, and proper disposal of all debris from performing the Work. Failure to clean up rubbish and debris shall serve as cause for withholding further payments to Subcontractor until such time as this condition is corrected to the satisfaction of DWA. Use of the dumpster located on the Project site is under the discretion of DWA, and all charges for use will be deducted from sums due Subcontractor. Daily clean up of all tools, equipment, material, and debris is required.

j. Loss/Theft. DWA assumes no responsibility whatsoever on account of any loss or damage to tools or equipment or for materials while on the Project site prior to installation. Further, DWA assumes no responsibility whatsoever on account of loss by theft or otherwise of Subcontractor's tools or equipment while on the Project site.

k. Subs. The Subcontractor represents and warrants the following to be the sole Subs and sole suppliers:

_____

_____

No Subs or suppliers may be changed without the written consent of DWA.

l. Punchlist Items. When the Subcontractor considers that the Work is substantially complete, the Subcontractor shall prepare and submit to DWA a comprehensive list of items to be completed or corrected prior to final payment (the "Punchlist"). DWA shall have the right to supplement the Punchlist with additional items that DWA, Architect, or Owner deems reasonably necessary to complete the Project based upon DWA's, Architect's, or Owner's independent inspection of the Work. Failure to include an item on the Punchlist shall not alter the responsibility of the Subcontractor to complete all Work in accordance with the Contract.

m. Final Completion. The Subcontractor shall cause Punchlist items to be completed within the timeframe, if any, determined by the Architect or, if no timeframe is so determined, then within thirty (30) days of the Completion Date. If the Subcontractor fails to correct or promptly commence to correct the deficiencies within the time period required for the Subcontractor to do so, DWA may, upon three (3) days written notice to the Subcontractor, take over and perform some or all of the Punchlist items. DWA may deduct from the final payment the actual cost to DWA of performing or causing others to perform these Punchlist items. DWA may withhold one hundred and fifty percent (150%) or the amount determined by the Architect, whichever is greater, of the estimated cost to complete the Punchlist items until Subcontractor completes the Punchlist items in accordance with the Contract or DWA completes or causes others to complete the Punchlist items.

4. SAFETY

The Subcontractor shall perform all Work in compliance with all Federal, State, and Local Safety regulations and standards (including OSHA), DWA's Safety rules and policies, and in such manner that will protect the Subcontractor's employees and others from injury. The Subcontractor shall require all persons, employees, workers, material men related to the performance of this Agreement to wear regulation hard hats and other required safety equipment while on the Project site. If Subcontractor's employees are found on the Project site not wearing hard hats and other required safety equipment after written notice has been previously given to comply with this provision, Subcontractor will be subject to a $25.00 per occurrence fine, which will be deducted from sums due Subcontractor. In addition, Subcontractor agrees to pay any and all fines, penalties and assessments resulting from its, its employees' and its Subs' failure to comply with any of the foregoing and to indemnify and hold DWA harmless from payment of the same. If any unsafe work is being performed by others on the Project and is observed by the Subcontractor, Subcontractor shall notify DWA immediately of such.

5. SURETY BOND

The Subcontractor agrees to furnish to DWA, at the Subcontractor's expense, a surety bond guaranteeing the faithful performance, including completion, of this Agreement and the payment of all labor and material bills in connection with the execution of the Work covered by this Agreement. The bond is to be written by a surety company designated or approved by DWA, and in a form satisfactory to DWA.

6. PERMITS, LICENSES, FEES, TAXES, ETC.

The Subcontractor shall, at Subcontractor's own cost and expense, apply for and obtain all necessary permits and licenses, and Subcontractor shall conform strictly to the laws, ordinances and regulations in force in the locality where the Work on the Project is being done. The Subcontractor shall indemnify and hold DWA harmless against liability by reason of the Subcontractor having failed to pay federal, state, county, or municipal taxes or to otherwise comply with applicable laws, ordinances and regulations.

7. INSURANCE

a. The Subcontractor agrees to comply in all respects with the employment and payment of labor required by law.

b. The Subcontractor agrees to carry comprehensive public liability and property damage insurance, and such other insurance as DWA might deem necessary, in an amount as approved by DWA in order to protect Owner, DWA and Subcontractor against loss resulting from any acts of the Subcontractor, its agents and/or employees, including but not limited to the following:

(1) Commercial General Liability policy (CGL) with limits not less than $1,000,000 each occurrence and $2,000,000 aggregate for the Work.

(a) CGL coverage must be written on ISO occurrence form CG 00 01 10/01 or an equivalent, providing coverage for the indemnifications required in this Agreement, including but not limited to independent contractors, products-completed operations, personal injury and property damage.

(b) DWA, Owner and all other parties required of DWA, must be named as an additional insured on the CGL policy using an additional insured endorsement that provides primary, non-contributory coverage AND completed operations coverage.

(c) The Subcontractor must maintain CGL coverage for itself and all additional insureds for the duration of the Work and maintain Complete Operations coverage for itself and each additional insured for at least 3 years after completion of the Work or the length of the state's statute of repose, whichever is greater.

(2) Business Automobile Liability coverage with limits of $1,000,000 for each accident. Coverage should include liability arising out of all owned, leased, hired and non-owned automobiles.

(3) Commercial Umbrella coverage with limits of at least $2,000,000. Coverage must include all entities that are additional insured on the CGL.

(4) Workers' Compensation and Employers' Liability coverage with limits of at least $500,000 for each accident, $500,000 for bodily injury by accident, and $500,000 each employee for injury by disease.

(5) To the fullest extent permitted by law, all policies must provide a waiver of subrogation on the CGL, Business Automobile, Workers' Compensation and Umbrella Liability policies.

(6) A copy of the additional insured endorsements and policies must be provided to DWA prior to commencement of Work or within seven (7) days of written request of DWA, whichever first occurs.

c. All insurance must provide at least thirty (30) days written notice to DWA prior to cancellation of any insurance. All insurance must have a Best's rating of no less than A- and must be authorized to do business in the state where the Project is located.

d. If any insurance coverage, clauses or limits beyond those provided herein are required in the Contract, the Subcontractor shall provide the same.

8. ASSUMPTION OF DUTIES AND INDEMNIFICATION

a. The Subcontractor assumes toward DWA all the obligations and responsibilities that DWA assumes toward the Owner. The Subcontractor shall indemnify DWA and the Owner against, and save them harmless from, any all loss, damage, expenses, costs, and attorney's fees incurred or suffered on account of any breach this Agreement, or any conditions, provisions or covenants of the Agreement.

To the fullest extend permitted by law, Subcontractor shall indemnify, defend, and hold harmless DWA and its agents, affiliates, and employees from and against all claims, liabilities, damages, losses, and expenses, including but not limited to attorney's fees, arising out of or resulting from the performance of the Work, provided that any such claim, liability, damage, loss or expense (1) is attributable to bodily injury, sickness, disease, or death, or to injury or destruction of tangible property including the loss of use resulting therefrom, or (2) due to any failure by Subcontractor to make any payment to Subs, materials providers, or others who have provided services or materials in connection with the Work. In the event of any collection action, payment bond claim, or mechanics lien filed by a labor or materials supplier against the Project for which DWA or Owner has paid or any other claim arising under this paragraph or Agreement, DWA may either (i) tender the defense of such claims to Subcontractor or (ii) retain an attorney and defend such claims and receive reimbursement from Subcontractor for all costs and attorney fees thereby incurred, and (3) is caused by whole or in part by an act or an omission of Subcontractor, anyone directly or indirectly employed by Subcontractor, or anyone for whose acts Subcontractor may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

9. CHANGES, ADDITIONS AND DEDUCTIONS

a. DWA may add or deduct from the amount of Work covered by this Agreement; and any changes made in the amount of Work involved, or any other parts of this Agreement, shall be by a written and signed amendment hereto setting forth in detail the changes involved and the value thereof which shall be mutually agreed upon between DWA and the Subcontractor; if mutual agreement is not possible, then the value of the Work shall be determined as provided in Section 11 of this Agreement. In either event, however, the Subcontractor agrees to proceed with the Work as changed when so ordered in writing by DWA so as not to delay the progress of the Work and pending any determination of the value thereof.

b. Change orders must be broken down by material and labor with markups as indicated in the specifications.

c. The Subcontractor agrees to make no claim for additional, extra or changed work outside the scope of this Agreement, and the terms hereof shall be conclusive with respect to this Agreement unless altered in writing signed by the parties.

d. The Subcontractor agrees not to sublet, transfer or assign this Agreement or any funds due or to become due or any part thereof without the written consent of DWA.

e. Any questions, clarifications, etc. must be submitted in writing to DWA as soon as they arise.

f. Subcontractor shall not proceed with any changes or alterations to the Plans and Specifications without written approval from Architect and DWA.

g. The Subcontractor shall promptly comply with construction directives.

10. BACK CHARGES

There will absolutely be no back charges and/or extra charges by Subcontractor against DWA or Owner, without prior approval in writing signed by DWA. Otherwise, any back charges are prohibited, null and void, and shall be absorbed by the Subcontractor. Any back charges assessed to the Subcontractor by DWA will be calculated at cost plus 10%.

11. DISPUTES

In the event of any dispute between DWA and Subcontractor relating specifically to the scope of the Work, the dispute shall be resolved in the manner provided by the Contract. If none be provided, or if there arises any dispute arising from or relating to the Agreement or the Work, then such disputes shall be first submitted to mediation with a qualified mediator determined by the parties to this Agreement, and if mediation is not successful, then resolved, in DWA's sole discretion, by an arbitration panel consisting of three members, one selected by DWA, one by the Subcontractor, and the third member shall be selected by the first two members. If DWA selects arbitration, DWA and Subcontractor agree to be bound by the findings of any such panel of arbitration, finally and without recourse to any courts of law. If DWA elects to resolve the dispute through litigation, any lawsuit, action, or proceeding arising out of or relating to this Agreement shall be instituted in the federal courts of the United States of America located in the State of Utah or the state courts of the State of Utah. Each party irrevocably submits to the exclusive jurisdiction of such courts in any suit, action, or proceeding relating to or arising from the Agreement. In the event there is a dispute between DWA and Subcontractor that arises out of this Agreement or relates to the Work, and if there is a court action or arbitration as a result of such dispute, the party that prevails in such action shall be entitled to recover from the other its reasonable attorneys' fees and costs, including expert witness fees, consultant fees, and reasonable deposition costs.

12. DEFAULT AND TERMINATION OF CONTRACT

a. Default. The following events, or any one of them, shall constitute events of default by the Subcontractor:

(1) Failure to perform Work as required by the Schedule;
(2) Failure or neglect to correct Work found to be defective by and at the reasonable discretion of DWA;
(3) Failure to supply materials which have been specified, or to supply the specified quality;
(4) Failure to supply materials of sufficient quantity;
(5) Failure to begin Work pursuant to the terms of this Agreement;
(6) Failure to supply a workforce of sufficient size or skill level;
(7) Failure to carry out and complete the Work without delay to the Project, DWA, or other subcontractors;
(8) Failure to make prompt payments for materials, labor, equipment and services provided to the Project;
(9) Failure to observe and abide by all applicable laws, ordinances, rules, regulations or orders of any public authority having jurisdiction over the Project;
(10) In the sole opinion of DWA, abandonment of the Project and the Subcontractor's Work under this Agreement;
(11) Failure to comply with the licensing laws of the state in which the Work is performed;
(12) Failure to comply with any of the terms of this Agreement;
(13) Reasonable doubt that the remaining Work of Subcontractor can be completed for the then unpaid balance to the Subcontractor.
(14) DWA in its reasonable discretion determines Subcontractor's ability to complete the Work or complete it in a timely manner is uncertain or unlikely.

b. Notice of Default. If the Subcontractor fails to perform in accordance with the terms of this Agreement, DWA may provide to Subcontractor a "Notice of Default" specifying the nature of the Subcontractor's default.

c. Remedy of Default. The Subcontractor shall have three (3) business days from the time of issuance of the Notice of Default to remedy and correct the default. However, if such default is not corrected within the terms or time limits required for performance under this Agreement, or if in the sole discretion of DWA, the Subcontractor will not be able to do so, DWA may terminate this Agreement and dismiss the Subcontractor from the Project and have the Work performed by itself or others.

(1) Termination of this Agreement by default shall not relieve the Subcontractor from obligations of warranty, quality and conformity of the Work, and any and all payments due from the Subcontractor or any other terms included in this Agreement.

(2) The Subcontractor agrees to release to DWA, without recourse, any materials on the Project site belonging to the Subcontractor for the benefit of completing the Work.

d. No Waiver of Default. No waiver by DWA of any of the provisions of this Agreement shall be effective unless explicitly set forth in writing and signed by DWA. Any failure by DWA to enforce or require the strict keeping and performance of any of the terms or conditions of this Agreement:

(1) Shall not constitute a waiver of the terms or conditions of this Agreement,

(2) Shall not affect or impair such terms or conditions in any way,

(3) Shall not impair or waive the right of DWA to avail itself of such remedies as it may have for any breach or breaches of the terms or conditions of this Agreement.

e. Termination.

(1) If the Work has been stopped, abandoned or suspended for more than ninety (90) calendar days not due to the fault or neglect of the Subcontractor, or if DWA has refused or neglected to pay amounts due to the Subcontractor pursuant to this Agreement within thirty (30) calendar days after such amounts have become due, and if DWA fails to cure such default within seven (7) business days after receiving a written notice from the Subcontractor of such default, then the Subcontractor may terminate this Agreement upon giving DWA seven (7) business days' prior written notice. The Subcontractor shall have no right to terminate this Agreement or suspend services hereunder on account of a failure by the Owner to make payment to DWA for all or any portion of the Work. Upon such termination, the Subcontractor shall be entitled to recover from DWA payment for all Work satisfactorily performed and for which payment has been received by DWA from the Owner but not yet paid to the Subcontractor. In no event shall DWA be liable to the Subcontractor or to persons or entities performing any portion of the Work for or on behalf of the Subcontractor, for any special, indirect or consequential damages or losses of anticipated profits arising out of a termination by the Subcontractor pursuant to this paragraph.

(2) Should the Owner terminate its Contract with DWA, or any part which includes the Work, DWA shall so notify the Subcontractor in writing in a timely matter, and upon written notification, this Agreement shall be terminated, and the Subcontractor shall immediately stop the Work, follow DWA's instruction regarding shutdown and termination procedures, and mitigate all costs. Any termination of this Agreement pursuant to this paragraph shall be without liability to DWA.

(3) DWA may, at any time, and at its sole discretion, terminate the Subcontractor without cause and without regard to any fault or failure to perform by any party, and solely for DWA's convenience. Termination by DWA for convenience shall be by notice of termination delivered to the Subcontractor specifying the effective date thereof. In the event of DWA's termination of the Agreement for convenience, DWA shall pay to the Subcontractor the portion of the Agreement price allocable to the Work satisfactorily completed prior to the effective date of termination and for which payment has been received by DWA from the Owner. In no event shall DWA be liable to the Subcontractor or persons or entities performing any portion of the Subs' Work for or on behalf of the Subcontractor, for any special, indirect, or consequential damages or losses of anticipated profits arising out of a termination of the Agreement by DWA for convenience pursuant to this paragraph. Upon a determination that a termination of the Agreement by DWA for cause was wrongful, such termination will be deemed converted to a termination for convenience pursuant to this paragraph and the Subcontractor's remedies for wrongful termination shall be limited to the recovery of the payments permitted for a termination by DWA for convenience as set forth in this paragraph.

(4) If the Subcontractor fails to correct or to commence and satisfactorily continue correction of a default within three (3) business days after written notification, then DWA may terminate the Agreement for cause. Upon such termination, DWA may use any materials, implements, equipment, appliances, or tools furnished by or belonging to the Subcontractor to complete the Work. DWA also may furnish those materials and equipment and/or employ such workers or subcontractors as DWA deems necessary to maintain the orderly progress of the Work. All costs and expenses incurred by DWA in performing the Work and in employing others to perform the Work, including reasonable overhead, profit, and attorneys' fees, shall be deducted from any monies due or to become due the Subcontractor under this Agreement. The Subcontractor shall be liable for the payment of any amount by which such costs and expenses plus any other damages suffered by DWA as a consequence of the Subcontractor's breach of this Agreement may exceed the unpaid balance of the Agreement price.

f. Conditions Following Subcontractor Termination for Cause.

(1) Right of Retention. Upon receipt or the sending of a Notification to Terminate, or upon termination of this Agreement for cause, the Subcontractor acknowledges the right of DWA to retain:

(a) Up to 10% of the total value of all Work performed by the Subcontractor through the expiration of the warranty period, or

(b) Up to 10% of the total value of all Work performed by the Subcontractor for a period not exceeding the statute of limitations for liens, or

(c) Up to 10% of the total value of all Work performed by the Subcontractor for a period not to exceed the time allowed by law for filing wage claims by the Subcontractor's employees.

(2) If the Subcontractor is called upon to perform warranty work and the Subcontractor fails to correct such Work within the warranty terms of this Agreement, DWA may use the retained funds to pay for the correction of the defective Work.

(3) Any funds retained pursuant to this Section shall be released in full to the Subcontractor within ten business days of the expiration of the applicable retention term if all warranty Work has been performed and completed pursuant to the terms of this Agreement.

g. Suspension. DWA may, for just cause or by direction, suspend all or part of the Subcontractor's Work. DWA will give written notice to the Subcontractor stating the nature, effective date and anticipated duration of such suspension, whereupon the Subcontractor shall suspend Work to the extent specified and shall place no further orders or perform no other Work except as permitted by DWA's notice of suspension. During the period of such suspension, the Subcontractor must care for all Work, materials, and equipment at the Project site or at storage areas under the Subcontractor's responsibility. The Agreement price shall be adjusted by Change Order if the cost of the Work is increased or decreased by reason of such suspension. If additional time for completion of the Work is required as a result of such suspension, the Subcontractor shall submit a written request for additional time prior to resuming the Work. Failure to submit a written request for additional time due to such suspension shall result in no extension of time being granted.

In the event the prime contract between the Owner and DWA should be terminated prior to its completion, then DWA and Subcontractor agree that an equitable settlement for Work performed (less damages and offsets) under this Agreement prior to such termination will be made as provided by the contract documents, if such provision be made; or, if none such exist, next by mutual agreement; or failing either of these methods, by arbitration as provided in Section 11.

13. FINANCIAL POSITION

Subcontractor herewith certifies that no bankruptcy proceeding has been filed in any chapter of the United States or State Bankruptcy Acts, and further that no such bankruptcy action is intended or contemplated by said Subcontractor, or if Subcontractor has filed or files a voluntary or any creditor files against Subcontractor an involuntary petition under any facet of the Bankruptcy Act, DWA may terminate this Agreement and immediately be relieved of any further obligations except as provided in Section 11 of this Agreement. Subcontractor also authorizes DWA to regularly, as determined by DWA obtain credit and other financial reports on Subcontractor.

14. ENFORCEMENT

Upon default, the defaulting party agrees to pay all costs and attorney's fees reasonably incurred by the party not in default in enforcing the terms of this Agreement of its rights herein.

15. SEVERABILITY

If any paragraph or portion of this Agreement is found illegal or unenforceable for any reason, the rest of this Agreement shall remain in full force and effect, and the failure of one clause shall not affect any other clause or paragraph of this Agreement.

16. GOVERNING LAW

All matters arising out of or relating to this Agreement shall be governed by and construed in accordance with the laws of the State of Utah without giving effect to any choice or conflict of law provision or rule.

DWA and Subcontractor signify their understanding and agreement with the terms by signing, and that this document incorporates the full understanding and agreement between the parties.

CONTRACTOR:

DWA CONSTRUCTION, INC.

DATED: 05/05/25

By: _____

Title: PRESIDENT

SUBCONTRACTOR:

NAME OF SUBCONTRACTOR

DATED: _____

By: _____

Title: _____

Tax Id No. _____

Form **W-9**
(Rev. March 2024)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Go to *www.irs.gov/FormW9* for instructions and the latest information.

Give form to the requester. Do not send to the IRS.

Before you begin. For guidance related to the purpose of Form W-9, see *Purpose of Form*, below.

Print or type. See ***Specific Instructions*** on page 3.

1 Name of entity/individual. An entry is required. (For a sole proprietor or disregarded entity, enter the owner's name on line 1, and enter the business/disregarded entity's name on line 2.)

2 Business name/disregarded entity name, if different from above.

3a Check the appropriate box for federal tax classification of the entity/individual whose name is entered on line 1. Check only **one** of the following seven boxes.

☐ Individual/sole proprietor ☐ C corporation ☐ S corporation ☐ Partnership ☐ Trust/estate

☐ LLC. Enter the tax classification (C = C corporation, S = S corporation, P = Partnership) . . . . .

Note: Check the "LLC" box above and, in the entry space, enter the appropriate code (C, S, or P) for the tax classification of the LLC, unless it is a disregarded entity. A disregarded entity should instead check the appropriate box for the tax classification of its owner.

☐ Other (see instructions)

3b If on line 3a you checked "Partnership" or "Trust/estate," or checked "LLC" and entered "P" as its tax classification, and you are providing this form to a partnership, trust, or estate in which you have an ownership interest, check this box if you have any foreign partners, owners, or beneficiaries. See instructions . . . . . ☐

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any)

Exemption from Foreign Account Tax Compliance Act (FATCA) reporting code (if any)

(Applies to accounts maintained outside the United States.)

5 Address (number, street, and apt. or suite no.). See instructions.

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. See also *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number

___ – ___ – ____

or

Employer identification number

__ – _____

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and, generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here **Signature of U.S. person** **Date**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9*.

What's New

Line 3a has been modified to clarify how a disregarded entity completes this line. An LLC that is a disregarded entity should check the appropriate box for the tax classification of its owner. Otherwise, it should check the "LLC" box and enter its appropriate tax classification.

New line 3b has been added to this form. A flow-through entity is required to complete this line to indicate that it has direct or indirect foreign partners, owners, or beneficiaries when it provides the Form W-9 to another flow-through entity in which it has an ownership interest. This change is intended to provide a flow-through entity with information regarding the status of its indirect foreign partners, owners, or beneficiaries, so that it can satisfy any applicable reporting requirements. For example, a partnership that has any indirect foreign partners may be required to complete Schedules K-2 and K-3. See the Partnership Instructions for Schedules K-2 and K-3 (Form 1065).

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS is giving you this form because they

SECTION 00 0103

PROJECT DIRECTORY

OWNER

Name: Cache County School District
Attention: Gary Thomas
Attention: Bruce Parker
Address: 84 East 2400 North, North Logan, UT 84341
Phone: (435) 752-3925

ARCHITECT

Name: Naylor Wentworth Lund Architects
Attention: Philip D. Wentworth, AIA
Attention: Jenna Liddell, AIA
Attention: Diego Garrido
Address: 723 West Pacific Ave., Suite 101, Salt Lake City, Utah 84104
Phone: (801) 355-5959

GENERAL CONTRACTOR

Name: DWA Construction
Attention: Jennifer Anderson, Project Manager
Address: 76 West 2400 North, North Logan, Utah 84321
Phone: (435) 752-6860

STRUCTURAL ENGINEER

Name: BHB Structural Engineering
Attention: Jordan Perks, Project Manager
Attention: Travis Brackus
Address: 2766 South Main Street, Salt Lake City, Utah 84115
Phone: (801) 355-5656
Fax: (801) 355-5950

MECHANICAL ENGINEER

Name: VBFA Engineers
Attention: Jed Jenkins, Project Manager
Address: 181 East 5600 South, Suite 200, Murray, Utah 84107
Phone: (801) 530-3148

ELECTRICAL ENGINEER

Name: BNA Consulting Engineers
Attention: Drayton Bailey, Project Manager
Address: 635 South State Street, Salt Lake City, Utah 84111
Phone: (801) 532-2196

CIVIL ENGINEER

Name: Cache Landmark Engineering
Attention: Lance Anderson, Project Manager

Address: 95 West Golf Course Road, Suite 101, Logan, Utah 84321
Phone: (307) 679-1709

FOOD SERVICE CONSULTANT

Name: W.S. Reich & Associates, L.L.C.
Attention: Ed Reich
Address: 2846 South 450 West, Bountiful, Utah 84010
Phone: (801) 295-4109

LANDSCAPE ARCHITECT

Name: Cache Landmark Engineering
Attention: Lance Anderson, Project Manager
Address: 95 West Golf Course Road, Suite 101, Logan, Utah 84321
Phone: (307) 679- 1709

HARDWARE CONSULTANT

Name: Allegion
Attention: George Stromquist
Phone: (801) 389-7905

AUDIO/VISUAL DESIGN

Name: BNA Consulting Engineers
Attention: Drayton Bailey, Project Manager
Address: 635 South State Street, Salt Lake City, Utah 84111
Phone: (801) 532-2196
Fax: (801) 532-2305

SECTION 00010 – ADVERTISEMENT FOR BIDS:

PROJECT: **CCSD Hyde Park Elementary School** for Cache County School District located at 333 East 300 North, Hyde Park, Utah 84318.

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DESCRIPTION: Provide lump sum bids for divisions 02000 through 32000 for Construction phase as per Architectural drawings and specifications. This project will begin April 25, 2025, and will occur through July 31, 2026.

TIME AND PLACE: DWA Construction, Inc. will receive contractor and supplier bids for the project at their Corporate Office located at 76 West 2400 North P.O. Box 3448, Logan, Utah 84323 on April 10, 2025 @ 3:00 PM. Faxed or emailed bids will be accepted. Please email bids to dwanate.h@dwaconstruct.com.

TYPE OF BID: The package will be awarded using a low bid best Value selection process.

PRE-BID MEETING: No pre-bid meeting will be held.

COMPLETION LIQUIDATED DAMAGE Liquidated damages will be assessed in the amount of $1,000.00 for each calendar day that the project is delayed based on the project schedule for each trade. Construction will begin April 25, 2025, and be completed by July 31, 2026.

BIDDING DOCUMENTS: Bidding documents will be available March 25, 2025, through the office of **DWA Construction, Inc.,** 76 West 2400 North P.O. Box 3448, Logan, Utah 84323 in accordance with the Instructions to Bidders. Bidders will be limited to one (1) set of documents. These sets **WILL NOT** be available to keep for the duration of the bidding. No partial sets of documents will be issued. Plans will also be available for viewing at our website www.dwaconstruct.com and the following plan rooms:

1. Builders Exchange Plan Rooms
   Phone: 775-329-7222 utahplanroom.com

2. DWA Construction, Inc.: 76 West 2400 North Logan, Utah 84341 Phone: (435) 752-6860 Fax (435) 752-7606

3. Intermountain Contractor: www.construction.com/projectcenter/.

PERFORMANCE AND PAYMENT: Upon receipt of a contract exceeding **$250,000.00**, the successful Contractor shall furnish to the Owner ***(at the CM/Owner's option)*** a 100 percent Performance and Payment Bond in accordance with the Instructions to Bidders.

BID BONDS Bid bonds will be required on all bids exceeding $250,000.00.

RIGHT TO REJECT BIDS: DWA Construction, Inc. and the Owner reserves the right to reject any or all bids and to waive any irregularities in any bid or in the bidding.

END OF SECTION

Invitation to Bid

March 24, 2025

ATTN: ESTIMATOR

PROJECT: **CCSD Hyde Park Elementary School**
333 East 300 North
Hyde Park, Utah 84318

BID DUE: **04/10/2025 @ 3:00 PM**
Please bid to us by 1:00 PM
This project is Tax Exempt
Questions are due – 04/03/2025 @ 4:00PM
All substitution requests must be submitted to DWA prior to 04/03/2025
DWA will provide access to Procore for all administrative correspondence upon award.

SPECIAL INSTRUCTIONS

DWA Construction, Inc., as CM/GC on the above referenced project, invite your firm to participate with us in bidding this project. Bidding documents are available at the locations shown below - please reserve ahead of time. You may fax (435-752-7606) or email (dwanate.h@dwaconstruct.com) bids to our office.

1. DWA Construction, Inc. – 76 West 2400 North – Logan, Utah – (435) 752-6860
2. DWA Construction, Inc. – Website: dwaconstruct.com
3. Builders Exchange Plan Rooms – 775-329-7222 – utahplanroom.com
4. McGraw-Hill Construction Dodge

Please advise us if you will or will not be submitting a bid on this project. If you have any questions concerning this project, please contact our office.

Sincerely,
Nathan Hansen
Senior Estimator
DWA CONSTRUCTION, INC

P.O. Box 3448
Logan, UT 84323-3448
www.dwaconstruct.com
Phone: 435-752-6860
Fax: 435-752-7606

SECTION 00 1115

ADVERTISEMENT FOR PREQUALIFICATION OF BIDDERS

PART 1 GENERAL

1.01 PROJECT INFORMATION

A. Project Name
B. Project Address
C. Owner Name
D. Owner Address
E. List Consultants
    1. Mechanical
    2. Electrical
    3. Civil
    4. Landscape
    5. Sturctural
F. CM/GC Name
G. Where will Drawings/Specifications be Posted
H. Pre-bid Walk Thru Date
    1. Mandatory Yes No
I. Final Questions Due Date
J. Bids Submitted How
K. Bids Due Date
L. Bids Opening Date and Place
M. Construction Start Date
N. Substantial Completion Date
O. Liquidated Damages Amount
P. Allowances Yes No
Q. Alternates Yes No
R. Unit Prices Yes No

1.02 SALES TAX

A. Beginning January 1, 1996, the State of Utah provided an exemption from sales tax for construction materials purchased for public education. The exemption applies to all construction materials purchased by or on behalf of institutions of the public education system, provided the construction materials are clearly identified and installed or converted to real property which is owned by the public education institution.
B. It is the intent of the Owner to take advantage of the tax exemption on all construction material used in the Hyde Park Elementary School. The Owner can take advantage of this exemption by structuring its agreements with its Contractors and suppliers so that title to construction material passes from the supplier to the Owner or the Contractor (on behalf of the Owner) upon delivery to the construction site after this date.

1.03 COMPLIANCE WITH LABOR LAWS

A. All Contractors shall comply with all applicable Laws and Regulations relating to labor on Public Works in the State of Utah, including *U.S. Code Title 8 USC Sec.1324a. Utah Code Title 34 Chapter 30 and Title 13 Chapter 47*.
B. Specific References

1. The following references are included herein so that the Contractor shall be aware of specific requirements of these sections. Other Law sections are not shown herein, but this in no way relieves the Contractor of His obligation to comply with all Federal, State, and Local Labor Laws.
    a. ***U.S. Code Title 8 USC Sec. 1324a Unlawful Employment*** (1)(A) It is unlawful for a person or other entity - to hire, or to recruit or refer for a fee, for employment in the United States an alien knowing the alien is an unauthorized alien. (2) ***Continuing Employment*** - It is unlawful for a person or other entity, after hiring an alien for employment in accordance with paragraph (1) to continue to employ the alien n the United States knowing the alien is (or has become) an unauthorized alien with respect to such employment. (4) ***Use of Labor Through Contract*** - For purposes of this section, a person or other entity who uses a contract, subcontract, or exchange, entered into, renegotiated, or extended after November 6, 1986, to obtain the labor of an alien in the United States knowing that the alien is an unauthorized alien (as defined in subsection (h)(3) of this section) with respect ot performing such labor, shall be considered to have hired the alien for employment in the United States in violation of paragraph (1)(A).
    b. ***Ut Code 34-30-1. Citizens to be given preference*** - In employing workmen in the construction of public works by the state or any county or municipality, **or by persons contracting with** the state or any county or municipality, preferences shall be given citizens of the United States, or those having declared their intention of becoming citizens. In each contract for the construction of public works a provision shall be inserted to the effect that, if the provisions of this section are not complied with, **the contract shall be void**.
    c. ***Ut Code 34-30-8. Forty-hour Work Week*** - Overtime at one and one-half regular rate. Forty hours shall constitute a working week on all works and undertakings carried on by the state, county, or municipal governments, or by any officer of the state or of any county or municipal government. Any persons, corporation, firm, contractor, agent, manager, or foreman, who shall require or contract with any person to work upon such works or undertakings longer than 40 hours in one week shall pay such employees at a rate not less than one and one-half times the regular rate at which he is employed. (Piece work rates have to be greater than or equal to minimum wage and one and one-half times minimum wage for hours worked over 40; minimum wage laws still apply.)
    d. ***Ut Code 34-30-9. Violation of Chapter*** - Failure to keep or produce records - Misdemeanor. Any officer, agent or representative of the state, or of any political subdivision, district, or municipality of it who shall violate, or omit to comply with any of the provisions of this chapter, and any contractor or subcontractor, or agent or representative thereof, doing such public work, who shall neglect to keep, or cause to be kept, an accurate record of the names, occupation and actual wages paid to each laborer, workman and mechanic employed by him, in connection with this public work or who shall refuse to allow access to same at any reasonable hour to any person authorized ot inspect same under this chapter shall be guilty of a misdemeanor.

e. ***Ut Code 13-47-201. Verification required for new hires***. (1) A private employer who employs 15 or more employees as of July 1, 2010, may not hire a new employee on or after July 1, 2010, unless the private employer: (a) is registered with the status verification system to verify the federal legal working status of any new employee; and (b) uses the status verification system to verify the federal legal working status of the new employee in accordance with the requirements of the status verification system. (2) This section does not apply to a private employer of a foreign national if the foreign national holds a visa issued in response to a petition by the private employer that is classified as H-2A or H-2B.

1.04 EMPLOYEE DRUG TESTING

A. Effective July 1, 2010, a state public procurement unit may not enter into a state construction contract unless the contractor has and will maintain a drug and alcohol testing policy during the period of the state construction contract that applies to the covered individuals hired by the contractor. Refer to Utah Code - Title 63G, Chapter 6, Section 604: **(63G-6-604: Drug and alcohol testing required for state construction contracts)**. Therefore, the successful Contractor and all subcontractors working on the Hyde Park Elementary School must show that they have a mandatory drug and alcohol testing policy for their company.

1.05 SUBSTANTIAL COMPLETION TIME

A. It is agreed by the parties to the contract that if the contractor shall fail to complete his work on or before the date set for substantial completion, or extension thereof granted by the owner, damage will be sustained by the owner and that it is, and will be, impracticable and extremely difficult to fix the actual damage with the owner will sustain in the event of and by reason of such delays. It is, therefore, agreed that the contractor will pay the owner **liquidated damages** in the sum of ???? $1000.00 per calendar day, for each day the contractor shall be in default. The contractor agrees that any sums which; may be due the owner as liquidated damages, may be deducted from any monies due, or to become due, the contractor under the contract or may be collected from the contractor's surety.
   1. Refer to Bid Form for the date of substantial completion ????.
   2. Refer to Bid Sync for the date of substantial completion ????.
   3. Date of substantial completion: ????Substantial Completion Date

1.06 MANUFACTURERS AND PRODUCTS

A. This specification was prepared under the direction of the Owner with regard to adhering to their established standards. Although the items are the Owner's preferred choice, suppliers may bid other manufacturers as proposed substitutions for the Owner's review. The use of brand names in this specification manual is not intended to limit bidding competition, but to establish a level of quality, performance and characteristics desired.

B. **Deadline for Proposed Substitution Requests will be ???? 72 hours prior to Bid Date. Refer to Section 01 6000 - Product Requirements.**

C. Note that substitutions for specified/approved products/manufacturers **will not** be reviewed if submitted as a part of submittal process.

D. Manufacturer's other than Basis of Design Manufacturers shall provide products or systems that meet or exceed Basis of Design products or systems. No change order shall be issued solely based on bid product or system not meeting Basis of Design and being rejected through submittal process.

END OF ADVERTISEMENT FOR PREQUALIFICATION OF BIDDERS

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BID FORM
Hyde Park Elementary School

Bid form must be completed in its entirety for bid to be considered.

Subcontractor/supplier name: _____

Business Address: _____

Point of Contact: _____

Phone Number: _____

Email Address: _____

Contractor License Number: _____

BID TO: DWA Construction, Inc.
76 West 2400 North - P.O. Box 3448 - Logan, Utah 84323-3448
Phone: 435-752-6860 Fax: 435-752-7606
E-mail: dwanate.h@dwaconstruct.com

PLEASE NOTE that this project is tax exempt – DO NOT include sales tax.
If you are bidding more than one specification section,
Please attach additional breakdown information.

Acknowledge addendums: (list each separately) ___, ___, ___, ___, ___, ___, ___, ___.

Bidding Section(s):

_____

_____

Base bid: ($_____)

Written amount: _____dollars

(In case of discrepancy between the written amount and numeral, written amount will govern)

ADDITIONAL INFORMATION NEEDED:

Mechanical:
Division 22-23: (Must be a complete bid)

Plumbing Contractor _____

Cost $ _____

HVAC Contractor _____

Cost $_____

Controls Contractor _____

Cost $_____

Test & Balance Contractor _____

Cost $_____

Insulation Contractor _____

Cost $_____

Electrical:

Division 26 (Must be a complete bid and include a temporary 400 AMP temporary service)

Electrical Contractor _____

Cost $_____

Fire Alarm System contractor _____

Cost $_____

Intercommunications System contractor _____

Cost $ _____

Sound System contractor _____

Cost $ _____

Sound Amplification System contractor _____

Cost $ _____

Division 27

Telecommunications cabling system contractor _____

Cost $ _____

Bid Alternate: Please provide additive or deductive alternate pricing to use Lutron Lighting Controls in lieu of the basis of design listed in the specifications. (Please Circle One) ADD DEDUCT

($_____)

Written amount: _____dollars

ADDITIONAL BIDDING REQUIREMENTS:

(Failure to respond where required may result in disqualification of bid)

1. Bids shall be priced lump sum to furnish and / or install all material and / or equipment as required by plans and specifications for a complete installation.

2. The construction duration portion of this project will be 14 months or less. Material and equipment must be delivered and installed in accordance with the Construction Manager's schedule as updated throughout the project. Liquidated damages are $1,000.00 per day. **See Advertisement for Bids.**

3. COST OF PAYMENT AND PERFORMANCE BOND: $_____.
Only bids over $250,000.00 will require a performance and payment bond at CM/Owner option.
(This amount will be added to the base bid amount, if payment and performance bonds are required. If no amount is provided, it will be presumed that the bidder is unable to bond for its work on this project and may be cause for rejection).

4. The Construction Manager and Owner reserve the right to accept or reject any, and all proposals or alternates with or without cause for any reason determined to be in the owner's best interest and to waive any bidding informality or irregularity.

5. The undersigned bidder, having examined the Drawings, Specifications and related documents in their entirety, and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of labor, hereby proposes to complete the work listed above in accordance with the Contract Documents and within the time set forth, at the price stated above and upon the subcontract form included in the Specifications. The above price is to cover all expenses incurred in performing the work required under the Contract Documents.

6. CONTRACTOR'S QUALIFICATION STATEMENT: Upon request the low bidders shall submit AIA Document A305 Contractor's Qualification Statement. Failure to show a statement satisfactory to the Owner or Construction Manager will be reason to reject the bid as non-responsive. Past performance on similar projects, the demonstrated ability to complete work on schedule and ability to perform the work on this project to the satisfaction of the Owner and Construction Manager will be a priority.

BY ITS SIGNATURE, BIDDER ACKNOWLEDGES THAT THE BID DOCUMENTS ARE A COMPLETE PACKAGE. BIDDER CERTIFIES IT HAS REVIEWED ALL BID DOCUMENTS TO DETERMINE ITS TOTAL SCOPE OF WORK AND HAVE INCLUDED ALL RELATED COSTS.

Name of Bidder

Authorized Signature

Printed name of authorized signature

Date

Contact phone number

Contractor License Number:

SECTION 00 5500

NOTICE TO PROCEED

PROJECT: **HYDE PARK ELEMENTARY SCHOOL**

PROJECT ADDRESS **333 EAST 300 NORTH, HYDE PARK, UTAH 84318**

DATE: _____

NOTICE:

YOU ARE HEREBY NOTIFIED TO COMMENCE WORK IN ACCORDANCE WITH THE FORM OF AGREEMENT DATED [_____], ON OR BEFORE [_____], AND YOU ARE TO COMPLETE THE WORK ON OR BEFORE [_____].

CERTIFIED BY:

_____
Owner's Name

_____
Printed Name

_____
Title

_____
Signature

RECEIPT OF THE ABOVE NOTICE TO PROCEED IS HEREBY ACKNOWLEDGED BY:

_____
Firm Name

_____
Print Name

_____
Title

_____
Signature

_____

Date

SECTION 00 6536
WARRANTY FORM

PROJECT INFORMATION

Project Name: Hyde Park Elementary School.
Project Address: 333 East 300 North, Hyde Park, Utah 84318
Owner: Cache County School District.
Owner's Address: 84 East 2400 North, North Logan, UT 84341

CONTRACTOR

Contractor Name: _____

Contractor's Address: _____

_____

GUARANTEE/WARRANTY

Date: _____

Know all persons by these present that, in consideration of my (our) having been awarded the Contract for complete furnishing and installation of: (List specific sections and extent of work.)

_____
_____
_____
_____

In conformity with the drawings and specifications prepared by Naylor Wentworth Lund Architects, 723 West Pacific Ave., Salt Lake City, Utah 84104.

We do hereby agree to return to the project with three (3) working days upon notification by the Owner that materials and/or workmanship has proven faulty and to repair, replace or otherwise make good to the full satisfaction of the Owner and/or Architect all such work (including adjacent work disturbed in completing required work under this warranty) without cost to the Owner.

This agreement shall remain in full force and effect until _____ year(s) from date of Substantial Completion established for the project by the Architect on the Certificate of Substantial Completion.

_____ Authorized Signature

_____ Title

_____ Contractor

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SECTION 00 7300

SUPPLEMENTARY CONDITIONS

THE FOLLOWING SUPPLEMENTS MODIFY THE GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, AIA DOCUMENT A201, 2017 EDITION. WHERE A PORTION OF THE GENERAL CONDITIONS IS MODIFIED OR DELETED BY THESE SUPPLEMENTARY CONDITIONS, THE REMAINING UNALTERED PORTIONS OF THE GENERAL CONDITIONS SHALL REMAIN IN AS IS.

ARTICLE 1 GENERAL PROVISIONS

1.1 Basic Definitions

Add to Subparagraph 1.1.4 - The Project as follows:

1.1.4 The project is more completely defined under Section 01 1000, Summary of Work.

1.2 Correlation and Intent of the Contract Documents

Add to Subparagraph 1.2.1 as follows:

1.2.1 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

1) The Agreement.
2) Addenda, with those of later date having precedence over those of earlier date.
3) The Supplementary Conditions.
4) The General Conditions of the Contract for Construction.
5) Drawings and Specifications.

In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of work shall be provided in accordance with the Architect's interpretation.

The Contractor shall not 'scale' the Contract Document drawings to define dimensions or locations of building walls, columns, etc. Review dimensioned drawings to define required locations, if not indicated, coordinate and review with the Architect prior to continuing construction.

Add new Subparagraph 1.2.4 as follows:

1.2.4 The omission of minor details of construction, installation, material or other essential items of usual or standard construction from the drawings or specifications shall not relieve the Contractor from furnishing the same in place complete. Such omission shall not entitle this Contractor to make claims for extras on material or labor.

ARTICLE 2 OWNER

2.2 Information and Services Required of the Owner

Delete Subparagraph 2.2.5. and substitute the following:

2.2.5 The Architect will furnish to the General Contractor a complete set of electronic format construction documents (drawings and specifications) for the project. It will then be the General Contractors responsibility to distribute said documents, either electronic or hard copy to his Subcontractors that will be necessary for the execution of the work.

ARTICLE 3 CONTRACTOR

3.6 Taxes

Delete Subparagraph 3.6.1 and substitute the following:

3.6.1 Beginning January 1, 1996, the State of Utah provided an exemption from sales tax for construction materials purchased for public education. The exemption applies to all construction materials purchased by or on behalf of institutions of the public education system, provided the construction materials are clearly identified and installed or converted to real property which is owned by the public education institution. It is the intent of the Owner to take advantage of the tax exemption on all construction material used in the Hyde Park Elementary School. The Owner can take advantage of this exemption by structuring its agreements with its Contractor and suppliers so that title to construction material passes from the supplier to the Owner or the Contractor (on behalf of the Owner) upon delivery to the construction site after January 1, 1996. Tax exempt form TC-721 must be used by the vendors when purchasing construction materials. The Owner will provide a Form TC-721, signed by the Owner Director of Purchasing, or designee, authorizing the exemption of sales tax on material purchases for the Contractor's use in purchasing materials. Refer to State Tax Commission, Publication 35, Rev. 6/96 or Tax Bulletin 16-96.

3.7 Permits, Fees, Notices and Compliance with Laws

Delete Subparagraph 3.7.1 and substitute the following:

3.7.1 The Contractor shall secure and the Owner shall pay for any permits, fees and inspections required by work included in this Contract. All licensing shall be secured and paid for by the Contractor.

Modify Subparagraph 3.7.4 as follows:

3.7.4 Three (3) days in lieu of twenty-one (21) days.

Modify Subparagraph 3.7.5 as follows:

3.7.5 Amend the first sentence in this subparagraph to read, “If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, wetlands or hazardous waste deposits not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect.”

3.8 Allowances

Modify Subparagraph 3.8.2.1 as follows:

.1 Allowances shall cover the total cost to the Contractor of materials and equipment delivered to the site, labor, installation costs, overhead and profit, other expenses contemplated, and all required taxes (if any) less applicable trade discounts.

Omit Subparagraph 3.8.2.2.

No changes to Subparagraph 3.8.2.3.

Add Subparagraph 3.8.2.4 as follows:

.4 At closeout of contract, funds remaining in Contingency Allowance will be credited to the Owner by Change Order.

3.10 Contractor's Construction Schedules

Modify Subparagraph 3.9.1 as follows:

3.10.1 In the first sentence change the word "promptly" to "within seven days of Owner/Architect acceptance of Subcontractor List”.

Add new Subparagraph 3.9.1.1 as follows:

.1 The Contractor shall show this information in the form of either C.P.M. or bar graph.

Modify Subparagraph 3.9.2 as follows:

3.10.2 In the first sentence change the word “promptly” to “within seven (7) days of Owner/Architect acceptance of Subcontractor List”.

3.10.2 Substitute the words, "Architect's Review," for "Architect's Approval," in this paragraph.

3.11 Documents and Samples at the Site

Add new Subparagraph 3.11.1 as follows:

3.11.1 The Contractor shall also be responsible for providing a work table and dedicated set of documents with addenda, change orders, etc. for use only by the special inspector.

3.12 Shop Drawings, Product Data and Samples

Modify Subparagraph 3.12.8 as follows:

3.12.8 Substitute the words, "Architect's Review," for "Architect's Approval," in this paragraph.

ARTICLE 4 ARCHITECT

4.2 Administration of the Contract

Modify Subparagraph 4.2.7 as follows:

4.2.7 Omit the words, "and approve" and add “and review” in the first sentence in this subparagraph.

4.2.7 Amend the last sentence in this subparagraph to read, "The Architect's review of a specific item shall not indicate approval of the item or the assembly of which the item is a component."

ARTICLE 5 SUBCONTRACTORS

5.2 Award of Subcontracts and other Contracts for Portions of the Work

Revise Subparagraph 5.2.1 as follows:

5.2.1 No later than twenty-four (24) hours after the date of commencement, the Contractor shall furnish in writing to the Owner, through the Architect, the names of persons or entities proposed as manufacturers for each of the products identified in the General Requirements (Division 1 of the Specifications) and, where applicable, the name of the installing Subcontractor. Coordinate with with Section 9.2.

Modify Subparagraph 5.2.4 as follows:

5.2.4 The Contractor shall not change a Subcontractor, person or entity previously selected without written notification and acceptance of the Owner and Architect.

ARTICLE 6

CONSTRUCTION BY THE OWNER OR BY SEPARATE CONTRACTORS

No modifications.

ARTICLE 7 CHANGES IN THE WORK

7.3 Construction Change Directives

Add new Subparagraph 7.3.7.6 as follows:

7.3.7.6 Refer to Section 01 2000 - Price and Payment Procedures, for allowed profit and overhead.

ARTICLE 8 TIME

8.2 Progress and Completion

Add new Subparagraph 8.2.4 as follows:

8.2.4 Substantial completion of the Work shall be achieved as stipulated on Bid Form and in Owner/Contractor Agreement..

ARTICLE 9 PAYMENTS AND COMPLETION

9.3 Applications for Payment

Add the following sentence to Subparagraph 9.3.1:

9.3.1 The form of Application for Payment shall be notarized AIA Documents G702 Application and Certificate for Payment and G703 Continuation Sheet.

Add new Subparagraph 9.3.1.3 as follows:

9.3.1.3 Until the Work is one hundred percent (100%) complete, the Owner shall pay ninety-five percent (95%) of the amount due the Contractor on account of progress payments.

9.6 Progress Payments

Modify Subparagraph 9.6.1 to read as follows:

9.6.1 Notice of extended payment provision. Application and certification for payment received by the fifth day of the month shall be reviewed and accepted or rejected by the tenth day of the month.

This Contract shall allow the Owner to make payment within thirty (30) days after acceptance of billings.

Delete Subparagraph 9.6.7 and substitute the following:

9.6.7 Upon the written request of the Contractor, made within ten days after the execution of the Contract. An escrow account shall be established in a financial institution chosen by the Contractor and approved by the Owner.

Add new Subparagraphs 9.6.8 through 9.6.12 as follows:

9.6.8 The escrow agreement shall provide that the financial institution will act as escrow agent, will pay interest on funds deposited in such account in accordance with the provisions of the escrow agreement and will disburse funds from the account upon the direction of the Owner as set forth below. Compensation to the escrow agent for establishing and maintaining the escrow account shall be paid from interest accrued in the escrow account.

9.6.9 As each progress payment is made, the retainage with respect to that payment shall be deposited by the Owner in the escrow account.

9.6.10 The interest earned on funds in the account shall accrue for the benefit of the Contractor until the completion date named in the Construction Contract or the expiration of any authorized extension of such date. Interest earned after such date shall accrue for the benefit of the Owner. Cost of compensation to the escrow agent paid out of interest earned shall be borne by the Contractor.

9.6.11 When the Contractor has fulfilled all of the requirements of the Contract providing for the reduction of retained funds, the escrow agent shall release to the Contractor one-half of the accrued funds but none of the interest thereon. When the Work has been fully completed in a satisfactory manner and the Architect has issued a final Certificate for Payment, the escrow agent shall pay to the Contractor the full amount of funds remaining in the account, including net balance of the interest paid to the account, less any interest that may have accrued for the benefit of the Owner, which thereupon shall be paid to the Owner.

9.6.12 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor, the escrow agent shall make payment to the Contractor as provided in Subparagraph 9.10.3.

9.8 Substantial Completion

Add the following sentence to Subparagraph 9.8.5:

9.8.5 The payment shall be sufficient to increase the total payments to 100 percent of the Contract Sum, less such amounts the Architect shall determine for incomplete Work and unsettled claims.

ADD NEW PARAGRAPH 9.11 AS FOLLOWS:

9.11 Liquidated Damages

9.11.1 The Contractor and the Contractor's surety shall be liable for and shall pay the Owner the sums hereinafter stipulated as **liquidated damages** for each calendar day of delay until the Work is substantially complete: ???? $1000.00

9.11.2 Should the Contractor fail to complete the Work within the time agreed upon in the Contract Documents, or within such additional time as may have been allowed by extension, there shall be deducted from any moneys due or that may become due the Contractor the sum as stated in paragraph 9.11.1. Such sum is fixed and agreed upon by the Owner and Contractor as liquidated damages due the Owner by reason of inconvenience and added costs of administration, engineering, and supervision resulting from the Contractor's default, and not as a penalty.

9.11.3 Permitting the Contractor to continue and finish the Work or any part of the Work after the time fixed for its completion, or after the date to which the time for completion may have been extended, shall in no way operate as a waiver on the part of the Owner of any of his rights under the Agreement.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

No modifications.

ARTICLE 11 INSURANCE AND BONDS

INSURANCE AND BONDS (VERIFY AMOUNTS FOR EACH PROJECT WITH OWNER)

In addition to the insurance required under Article 11, the Contractor shall effect and maintain the following insurance:

COVERAGE	HAZARDS	LIMITS OF LIABILITY
Liability	Other than auto	$1,000,000 each occurrence
		$1,000,000 aggregate
Property Damage	Other than auto	$1,000,000 aggregate
Bodily Injury	Automobile	$1,000,000 each person
		$1,000,000 aggregate
Property Damage	Automobile	$500,000 each occurrence
		$1,000,000 annual aggregate

The above policy shall name the Owner and the Architect as additional insured. Reference is made to Paragraph 3.18, Indemnification, of AIA Document A201.

Contractor shall furnish the Owner with certificates of insurance complying with all requirements. The certificates shall be signed by a person authorized to bind coverage on the insurer's behalf. Coverage on a claims-made basis will not be acceptable.

11.3 Property Insurance

Delete Subparagraph 11.3.1.4 and substitute the following:

11.3.1.4 The Contractor shall provide insurance coverage for portions of the Work stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the Work in transit.

11.4 Performance Bond and Payment Bond

Delete Subparagraph 11.4.1 and substitute the following:

11.4.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment obligations arising there under. Costs of bonds shall be included in the Contractor's bid. The amount of each bond shall be equal to one hundred percent (100%) of the Contract Sum.

11.4.1.1 The Contractor shall deliver the required bonds to the Owner not later than three days following the date the Agreement is entered into.

11.4.1.2 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

ARTICLE 12

UNCOVERING AND CORRECTION OF WORK

No modifications.

ARTICLE 13 MISCELLANEOUS PROVISIONS

13.5 Tests and Inspections

Modify Subparagraph 13.5.1 as follows:

13.5.1 Substitute the words, "review or reviews," wherever the words, "approve, approval, or approvals," occur in this paragraph.

ADD NEW PARAGRAPH 13.8 AS FOLLOWS:

13.8 Equal Opportunity

13.8.1 The Contractor shall maintain policies of employment as follows:

.1 The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

.2 The Contractor and the Contractor's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.

ADD NEW PARAGRAPH 13.9 AS FOLLOWS:

13.9 Compliance with Labor Laws

13.9.1 The Contractor and the Contractor's Subcontractors shall comply with all applicable Laws and Regulations relating to labor on Public Works in the State of Utah, including *U.S. Code Title 8 USC Sec.1324a, Utah Code Title 34 Chapter 30 ant Title 13 Chapter 47*:

13.9.2 The following references are included herein so that the Contractor shall be aware of specific requirements of these sections. Other Law sections are not shown herein, but this in no way relieves the Contractor of His obligation to comply with all Federal, State, and Local Labor Laws.

.1 ***U.S. Code Title 8 USC Sec. 1324a Unlawful Employment*** (1)(A) It is unlawful for a person or other entity - to hire, or to recruit or refer for a fee, for employment in the United States an alien knowing the alien in an unauthorized alien. (2) ***Continuing Employment*** - It is unlawful for a person or other entity, after hiring an alien for employment in accordance with paragraph (1) to continue to employ the alien in the United States knowing the alien in (or has become) an unauthorized alien with respect to such employment. (4) ***Use of labor through contract*** - For purposes of this section, a person or other entity who uses a contract, subcontract, or exchange, entered into, renegotiated, or extended after November 6, 1986, to obtain the labor of an alien in the United States knowing that the alien is an unauthorized alien (as defined in subsection (h)(3) in this section) with respect to performing such labor, shall be considered to have hired the alien for employment in the United States in violation of paragraph (1)(A).

.2 ***Ut Code 34-30-1. Citizens to be given preference*** - In employing workmen in the construction of public works by the state or any county or municipality, or by persons contracting with the state or any county or municipality, preference shall be give to citizens of the United States, or those having declared their intention of becoming citizens. In each contract for the construction of public works a provision shall be inserted to the effect that, if the provisions of this section are not complied with, the contract shall be void.

.3 ***Ut Code 34-30-8. Forty-hour work week*** - Forty hours shall constitute a working week on all works and undertakings carried on by the state, county, or municipal governments, or by any officer of the state or of any county or municipal government. Any persons, corporation, firm, contractor, agent, manager, or foreman, who shall require contract with any person to work upon such works or undertakings longer than 40 hours in one week shall pay such employees at at rate not less than one and one-half times the regular rate at which he is employed. (Piece work rates have to by greater than or equal to minimum wage and one and one-half times minimum wage for hours worked over 40; Minimum wage and overtime laws still apply).

.4 ***Ut Code 34-30-9. Violation of chapter*** - Any officer, agent, or representative if the state or of any political subdivision, district or municipality of it who shall violate, or omit to comply with any of the provisions of this chapter, and any contractor or subcontractor, or agent or representative thereof, doing such public work, who shall neglect to keep, or cause to be kept, an accurate record of the names, occupation and actual wages paid to each laborer, workman and mechanic employed by him, in connection with this public work or who shall refuse to allow access to same at any reasonable hour to any person authorized to inspect same under this chapter shall be guilty of a misdemeanor.

.5 ***Ut Code 13-47-201. Verification required for new hires*** - (1) A private employer who employs 15 or more employees as of July 1, 2010, may not hire a new employee on or after July 1, 2010, unless the private employer: (a) is registered with a status verification system to verify the federal legal working status of any new employee; and (b) uses the status verification system to verify the federal legal working status of the new employee in accordance with the requirements of the status verification system. (2) This section does not apply to a private employer of a foreign national if the foreign national holds a visa issued in response to a petition by the private employer that is classified as H-2A or H-2B.

ARTICLE 15 CLAIMS AND DISPUTES

15.1 Claims

Add this sentence to the end of Subparagraph 15.1.1:

15.1.1 A claim must contain the following explicit language in order to be recognized as a "Claim": **"THIS IS A CLAIM AS DEFINED BY CLAUSE 15.1.1 OF AIA DOCUMENT A201."**

Modify Subparagraph 15.1.2 as follows:

15.1.2 Substitute 10 days for 21 days, where the latter occurs in this subparagraph.

ADD NEW PARAGRAPH 15.5 AS FOLLOWS:

15.5 Time Limits on Claims

15.5.1 For time limits on claims, refer to Section 13.7.

END OF SUPPLEMENTARY GENERAL CONDITIONS

Utah State Tax Commission

Exemption Certificate for Governments & Schools

(Sales, Use, Tourism and Motor Vehicle Rental Tax)

TC-721G
Rev. 5/18

Name of institution claiming exemption (purchaser)		Telephone Number	
DWA Construction, Inc.		435-752-6860	
Street Address	City	State	ZIP Code
76 West 2400 North Po Box 3448	Logan	Utah	84323
Authorized Signature	Name (please print)	Title	
	Jill Krueger	Administrative Assistant	
Name of Seller or Supplier:		Date	

The person signing this certificate MUST check the applicable box showing the basis for which the exemption is being claimed.

Email questions to **taxmaster@utah.gov.** You may also write or visit the Tax Commission at 210 N 1950 W, Salt Lake City, UT 84134, or call 801-297-2200 or toll free 1-800-662-4335.

DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION
Keep it with your records in case of an audit.

Print Form

Clear form

☐ **UNITED STATES GOVERNMENT OR NATIVE AMERICAN TRIBE**
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of essential governmental or tribal functions. **NOTE:** Includes sales of tangible personal property to federally chartered credit unions. "Directly" does not include per diem, entity advances, or government reimbursements for employee credit card purchases.

☒ **CONSTRUCTION MATERIALS PURCHASED FOR SCHOOLS OR PUBLIC TRANSIT DISTRICTS**
I certify the construction materials purchased are on behalf of a public elementary or secondary school, or public transit district. I further certify the purchased construction materials will be installed or converted into real property owned by the school or public transit district.
Name of school or public transit district: Cache County School District
Name of project: _____

☐ **FOREIGN DIPLOMAT**
I certify the purchases are authorized by a diplomatic tax exemption card issued by the United States.
Foreign diplomat number: _____

☐ **Construction Materials Purchased for Airports**
I certify the construction materials are purchased by, on behalf of, or for the benefit of Salt Lake International Airport, or a new airport owned or operated by a city in Davis, Utah, Washington or Weber County. I further certify the construction materials will be installed or converted into real property owned by and located at the airport.

☒ **UTAH LOCAL GOVERNMENTS AND PUBLIC ELEMENTARY AND SECONDARY SCHOOLS**
Sales Tax License No. 12286526-010-STC
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of that entity's essential functions. For construction materials, if the purchaser is a Utah local government, these construction materials will be installed or converted into real property by employees of this government entity.
CAUTION: This exemption does not apply to government or educational entities of other states and is not valid for lodging-related purchases.

☐ **UTAH STATE GOVERNMENT**
Sales Tax License No. _____
I certify the tangible personal property or services purchased are to be paid directly with funds from the entity noted on this form and will be used in the exercise of its essential functions. For construction materials, they will be installed or converted into real property by employees of this government entity.
CAUTION: This exemption does not apply to other states and is not valid for lodging-related purchases.

☐ **HEBER VALLEY HISTORIC RAILROAD**
I certify these purchases and sales are by the Heber Valley Historic Railroad Authority or its operators and are related to the operation and maintenance of the Heber Valley Historic Railroad.

IMPORTANT: To protect your privacy, use the "Clear form" button when you are finished. Clear form

To be valid this certificate must be filled in completely, including a check mark in the proper box.

A sales tax license number is required only where indicated.

Please sign, date and, if applicable, include your license or exemption number.

NOTE TO SELLER: Keep this certificate on file since it must be available for audit review.

NOTE TO PURCHASER: Keep a copy of this certificate for your records. You must notify the seller of cancellation, modification, or limitation of the exemption you have claimed.

If you need an accommodation under the Americans with Disabilities Act, email **taxada@utah.gov**, or call 801-297-3811 or TDD 801-297-2020. Please allow three working days for a response.

SECTION 01 2300

ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.
B. Procedures for pricing Alternates.
C. Documentation of changes to Contract Sum and Contract Time.

1.02 RELATED REQUIREMENTS

A. AIA Document A701 - Instructions to Bidders: Instructions for preparation of pricing for alternatives.
B. AIA Document A101 - Owner-Contractor Agreement: Incorporating monetary value of accepted alternatives.

1.03 COSTS INCLUDED

A. Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of Work, including overhead and profit.

1.04 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.05 SCHEDULE OF ALTERNATES

A. Alternate #1
    1. Base Bid: Wattstopper System.
    2. Alternate: Lutron Vive and/or Athena lighting control system.
        a. Per Section 26 0943 - Lighting Control Equipment, the base lighting control system shall be a Wattstopper system. As an alternate, a Lutron Vive and/or Athena lighting control system may be submitted under Alternate No. 1, accounting for any adjustments to system and labor costs. Any proposed alternative shall include necessary drawing adjustments and provide a complete, fully operational system that meets or exceeds the performance of the specified basis of design.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2300

SECTION 01 3000

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Electronic document submittal.
C. Preconstruction meeting.
D. Progress meetings.
E. One year warranty inspection meeting.
F. Coordination drawings.
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Information (RFI) procedures.
J. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. AIA Document A201 - General Conditions and Supplementary Conditions: Dates for applications for payment and duties of the Construction Manager.
B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
C. Section 01 7700 - Closeout Procedures: Additional coordination requirements.
D. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 7700 - Closeout Procedures for coordination of execution of administrative tasks with timing of construction activities.

1.04 PROJECT COORDINATOR

A. Project Coordinator: General Contractor
B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for job site access, traffic, and parking facilities.
C. During construction, coordinate use of site and facilities through the Project Coordinator.
D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 1100 - Summary of Work.
F. Coordinate layout work under instructions of the Project Coordinator.
G. Make the following types of submittals to Architect through the Project Coordinator:
    1. Requests for Interpretation.
    2. Requests for substitution.
    3. Shop drawings, product data, and samples.
    4. Test and inspection reports.
    5. Design data.
    6. Manufacturer's instructions and field reports.

7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Project Manager/General Contractor and Architect are required to use this method.
   3. It is Contractor's and Subcontractor's responsibility to submit documents in PDF format.
   4. Users need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com or similar software).
   5. Paper document transmittals will not be reviewed.
   6. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

3.02 PRECONSTRUCTION MEETING

A. The Contractor will schedule a meeting after Notice of Award.
B. Attendance Required:
   1. Owner Representative.
   2. Architect.
   3. Construction Manager/General Contractor.
   4. Subcontractors.
C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Execution of CM/GC Agreements.
   3. Submission of executed bonds and insurance certificates.
   4. Distribution of Contract Documents.
   5. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   6. Submission of initial Submittal schedule.
   7. Designation of personnel representing the parties to Contract, _____ and Architect.
   8. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   9. Tentative construction scheduling.
   10. Critical work sequencing.
   11. Procedures for processing Applications for Payment.
   12. Preparation of record documents.
   13. Use of the premises.

14. Office, work and storage areas.
15. Equipment deliveries and priorities.
16. Safety procedures.
17. First aid.
18. Security.
19. Housekeeping.
20. Working hours.
21. Specific instructions from the Owner.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum of weekly intervals.
B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner Representative, Architect, Engineers, and Inspectors as appropriate to agenda topics for each meeting.
D. Agenda:
    1. Review minutes of previous meetings.
    2. Review of work progress.
    3. Field observations, problems, and decisions.
    4. Identification of problems that impede, or will impede, planned progress.
    5. Review of submittals schedule and status of submittals.
    6. Review of RFIs log and status of responses.
    7. Review of off-site fabrication and delivery schedules.
    8. Maintenance of progress schedule.
    9. Corrective measures to regain projected schedules.
    10. Planned progress during succeeding work period.
    11. Coordination of projected progress.
    12. Maintenance of quality and work standards.
    13. Effect of proposed changes on progress schedule and coordination.
    14. Other business relating to work.
E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.04 ONE YEAR WARRANTY INSPECTION (MANDATORY)

A. The Contractor will be required to visit the site one year after Substantial Completion with the assigned representative of the Cache County School District and the Architect to review warranty issues. A warranty punch list will be issued and the General Contractor will be responsible to complete these warranty items. Additional inspections will take place as required.

3.05 CONSTRUCTION PROGRESS SCHEDULE- SEE SECTION 01 3216

3.06 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.
B. Review drawings prior to submission to Architect.

3.07 REQUESTS FOR INFORMATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
   2. Prepare in a format and with content acceptable to Owner.
   3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

C. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
   1. Official Project name and number, and any additional required identifiers established in Contract Documents.
   2. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.
   4. Issue date, and requested reply date.
   5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
   6. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example: Routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

D. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

3.08 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Provide Bookmarks for each listing.

D. Do not submit MSDS info.

E. Samples will be reviewed for aesthetic, color, or finish selection.

F. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

G. Note that substitutions for specified/approved products/manufacturers will not be reviewed if submitted as a part of submittal process.

3.09 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.
B. Submit for Architect's knowledge as contract administrator or for Owner.

3.10 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List prior to Substantial Completion.
B. Submit Final Correction Punch List prior to Substantial Completion.
C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties/Guarantees.
   4. Bonds.
   5. Other types as indicated.
D. Submit for Owner's benefit during and after project completion.

3.11 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
B. Extra Copies at Project Closeout: See Section 01 7800.
C. Samples: Submit the number specified in individual specification sections, one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.12 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a separate transmittal for each item.
   2. Organize and number submittals by spec section. For example, in AA AAAA-BB-CC, the ‘A’s represent spec section; the ‘B’s represent sequence number. If more than one submittal is required for each spec section (i.e. Casework for phase-1, phase-2, etc.), ‘C’s represent Revision number if submittal has to be resubmitted (wrong or incomplete information). Submittals can be broken up (example: 06 4100-01-00); this may be preferred for some sections. Submit items under their spec section number only. This applies particularly to electrical and mechanical. If a sub is supplying items from multiple sections, they should be submitted as separate submittals.
      a. Notwithstanding the requirement to submit each specification section separately, mechanical and electrical submittals should be submitted as complete divisions.
   3. Identify: Project, Contractor, subcontractor or supplier, pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.

4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
    a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
5. Send submittals in electronic format via email to Architect.
6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
7. Provide space for Contractor and Architect review stamps.
8. Submittals not requested will be recognized, and will be returned "Not Reviewed".

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
1. Shop Drawings: Shop drawings must be reviewed and stamped by the Prime Contractor prior to submittal to the Architect. (If the stamp is missing or if it is obvious shop drawings have not been reviewed by the Prime Contractor, they will be returned for re-submittal unchecked by the Architect.)
2. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
3. Do not reproduce Contract Documents to create shop drawings.
4. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.13 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

C. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
    a. "No Exception Taken" - No further action is required from Contractor.
    b. "Make Noted Corrections" - No further action is required from Contractor.
2. Not authorizing fabrication, delivery, and installation:
    a. "Revise and Resubmit" - Further action is required from Contractor.
        1) Resubmit revised item, with review notations acknowledged and incorporated.
    b. "Rejected" - Further action is required from Contractor.
        1) Submit item complying with requirements of Contract Documents.

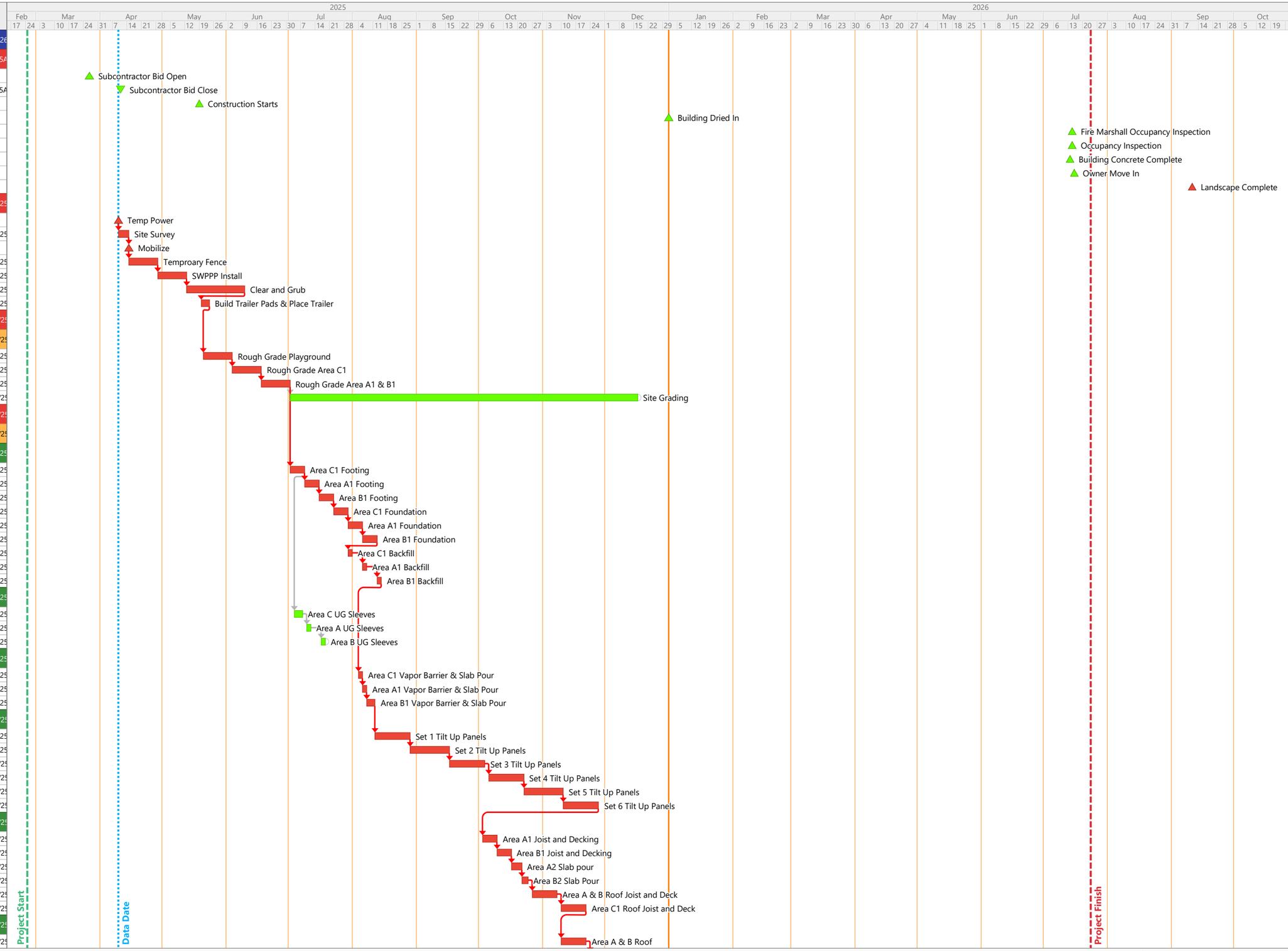
D. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
    a. "Received" - To notify the Contractor that the submittal has been received for record only.

2. Items for which action was taken:
    a. "No Exception Taken" - No further action is required from Contractor.
    b. "Make Noted Corrections" - Further action is required from Contractor.
    c. "Revise and Resubmit" - Further action is required from Contractor.
    d. "Rejected" - Further action is required from Contractor.

END OF SECTION 01 3000

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ID	Description	Original Duration	Start	Finish
Hyde Park Elementary		381	03/27/25A	07/23/26
Milestone		381	03/27/25A	04/10/25A
10	Subcontractor Bid Open	0	03/27/25A	
20	Subcontractor Bid Close	0		04/10/25A
30	Construction Starts	0	05/19/25A	
35	Building Dried In	0	01/01/26A	
38	Fire Marshall Occupancy Inspection	0	07/15/26A	
39	Occupancy Inspection	0	07/15/26A	
45	Building Concrete Complete	0	07/14/26A	
47	Owner Move In	0	07/16/26A	
48	Landscape Complete	0	09/11/26A	
Pre Construction		43	04/10/25	06/09/25
40	Temp Power	0	04/10/25	
50	Site Survey	3	04/10/25	04/14/25
60	Mobilize	0	04/15/25	
70	Temproary Fence	10	04/15/25	04/28/25
80	SWPPP Install	10	04/29/25	05/12/25
85	Clear and Grub	20	05/13/25	06/09/25
90	Build Trailer Pads & Place Trailer	4	05/20/25	05/23/25
Site Earthwork		150	05/21/25	12/16/25
Excavation		150	05/21/25	12/16/25
110	Rough Grade Playground	10	05/21/25	06/03/25
120	Rough Grade Area C1	10	06/04/25	06/17/25
130	Rough Grade Area A1 & B1	10	06/18/25	07/01/25
140	Site Grading	120	07/02/25	12/16/25
Building Shell		118	07/02/25	12/12/25
Exterior		118	07/02/25	12/12/25
Footings & Foundation		32	07/02/25	08/14/25
180	Area C1 Footing	5	07/02/25	07/08/25
190	Area A1 Footing	5	07/09/25	07/15/25
200	Area B1 Footing	5	07/16/25	07/22/25
210	Area C1 Foundation	5	07/23/25	07/29/25
220	Area A1 Foundation	5	07/30/25	08/05/25
230	Area B1 Foundation	5	08/06/25	08/12/25
240	Area C1 Backfill	2	07/30/25	07/31/25
250	Area A1 Backfill	2	08/06/25	08/07/25
260	Area B1 Backfill	2	08/13/25	08/14/25
UG Utilities		11	07/04/25	07/18/25
150	Area C UG Sleeves	2	07/04/25	07/07/25
160	Area A UG Sleeves	2	07/10/25	07/11/25
170	Area B UG Sleeves	2	07/17/25	07/18/25
Vapor Barrier and Slab Pour		6	08/04/25	08/11/25
270	Area C1 Vapor Barrier & Slab Pour	2	08/04/25	08/05/25
280	Area A1 Vapor Barrier & Slab Pour	2	08/06/25	08/07/25
290	Area B1 Vapor Barrier & Slab Pour	2	08/08/25	08/11/25
Tilt Up Panels		78	08/12/25	11/27/25
300	Set 1 Tilt Up Panels	13	08/12/25	08/28/25
310	Set 2 Tilt Up Panels	13	08/29/25	09/16/25
320	Set 3 Tilt Up Panels	13	09/17/25	10/03/25
330	Set 4 Tilt Up Panels	13	10/06/25	10/22/25
340	Set 5 Tilt Up Panels	13	10/23/25	11/10/25
350	Set 6 Tilt Up Panels	13	11/11/25	11/27/25
Joist & Decking		36	10/03/25	11/21/25
360	Area A1 Joist and Decking	5	10/03/25	10/09/25
370	Area B1 Joist and Decking	5	10/10/25	10/16/25
380	Area A2 Slab pour	3	10/17/25	10/21/25
390	Area B2 Slab Pour	3	10/22/25	10/24/25
400	Area A & B Roof Joist and Deck	10	10/27/25	11/07/25
420	Area C1 Roof Joist and Deck	10	11/10/25	11/21/25
Roofing		25	11/10/25	12/12/25
425	Area A & B Roof	10	11/10/25	11/21/25



Start Date: 02/25/25
Finish Date: 07/23/26
Data Date: 04/10/25
Run Date: 03/20/25
Prebid Schedule.ppx

Preliminary Schedule
Schedule is subject to change

Section 01 3216 Construction Progress Schedule

DM CONSTRUCTION INC.

ID	Description	Original Duration	Start	Finish
1070	Area C Roof	15	11/24/25	12/12/25
Interior Building		184	11/10/25	07/23/26
Interior		184	11/10/25	07/23/26
Windows & Aluminum Storefronts		60	11/24/25	02/13/26
430	Area B1	20	11/24/25	12/19/25
440	Area B2	20	12/22/25	01/16/26
450	Area A1	5	01/19/26	01/23/26
460	Area A2	5	01/26/26	01/30/26
470	Area C1	10	02/02/26	02/13/26
Metal Framing		30	11/10/25	12/19/25
530	Area A1	5	11/10/25	11/14/25
540	Area B1	5	11/17/25	11/21/25
550	Area A2	5	11/24/25	11/28/25
560	Area B2	5	12/01/25	12/05/25
570	Area C1	10	12/08/25	12/19/25
MEP Overhead		55	11/24/25	02/06/26
480	Area A1	10	11/24/25	12/05/25
490	Area B1	10	12/08/25	12/19/25
500	Area A2	10	12/22/25	01/02/26
510	Area B2	10	01/05/26	01/16/26
520	Area C1	15	01/19/26	02/06/26
MEP Wall Rough In		50	02/09/26	04/17/26
580	Area A1	10	02/09/26	02/20/26
590	Area B1	10	02/23/26	03/06/26
600	Area A2	10	03/09/26	03/20/26
610	Area B2	10	03/23/26	04/03/26
620	Area C1	10	04/06/26	04/17/26
Gyboard and Insulation		50	02/23/26	05/01/26
630	Area A1	10	02/23/26	03/06/26
640	Area B1	10	03/09/26	03/20/26
650	Area A2	10	03/23/26	04/03/26
660	Area B2	10	04/06/26	04/17/26
670	Area C1	10	04/20/26	05/01/26
Paint		25	04/01/26	05/05/26
680	Area A1	5	04/01/26	04/07/26
690	Area B1	5	04/08/26	04/14/26
700	Area A2	5	04/15/26	04/21/26
710	Area B2	5	04/22/26	04/28/26
720	Area C1	5	04/29/26	05/05/26
Tile		52	04/15/26	06/25/26
730	Area A1	6	04/15/26	04/22/26
740	Area B1	17	04/23/26	05/15/26
750	Area A2	6	05/18/26	05/25/26
760	Area B2	17	05/26/26	06/17/26
770	Area C1	6	06/18/26	06/25/26
Flooring		25	06/12/26	07/16/26
780	Area A1	5	06/12/26	06/18/26
790	Area B1	5	06/19/26	06/25/26
800	Area A2	5	06/26/26	07/02/26
810	Area B2	5	07/03/26	07/09/26
820	Area C1	5	07/10/26	07/16/26
Ceiling Grid & Overhead MEP Finish T		25	06/19/26	07/23/26
830	Area A1	5	06/19/26	06/25/26
840	Area B1	5	06/26/26	07/02/26
850	Area A2	5	07/03/26	07/09/26
860	Area B2	5	07/10/26	07/16/26
870	Area C1	5	07/17/26	07/23/26
Millwork		25	05/28/26	07/01/26
880	Area A1	5	05/28/26	06/03/26
890	Area B1	5	06/04/26	06/10/26
900	Area A2	5	06/11/26	06/17/26

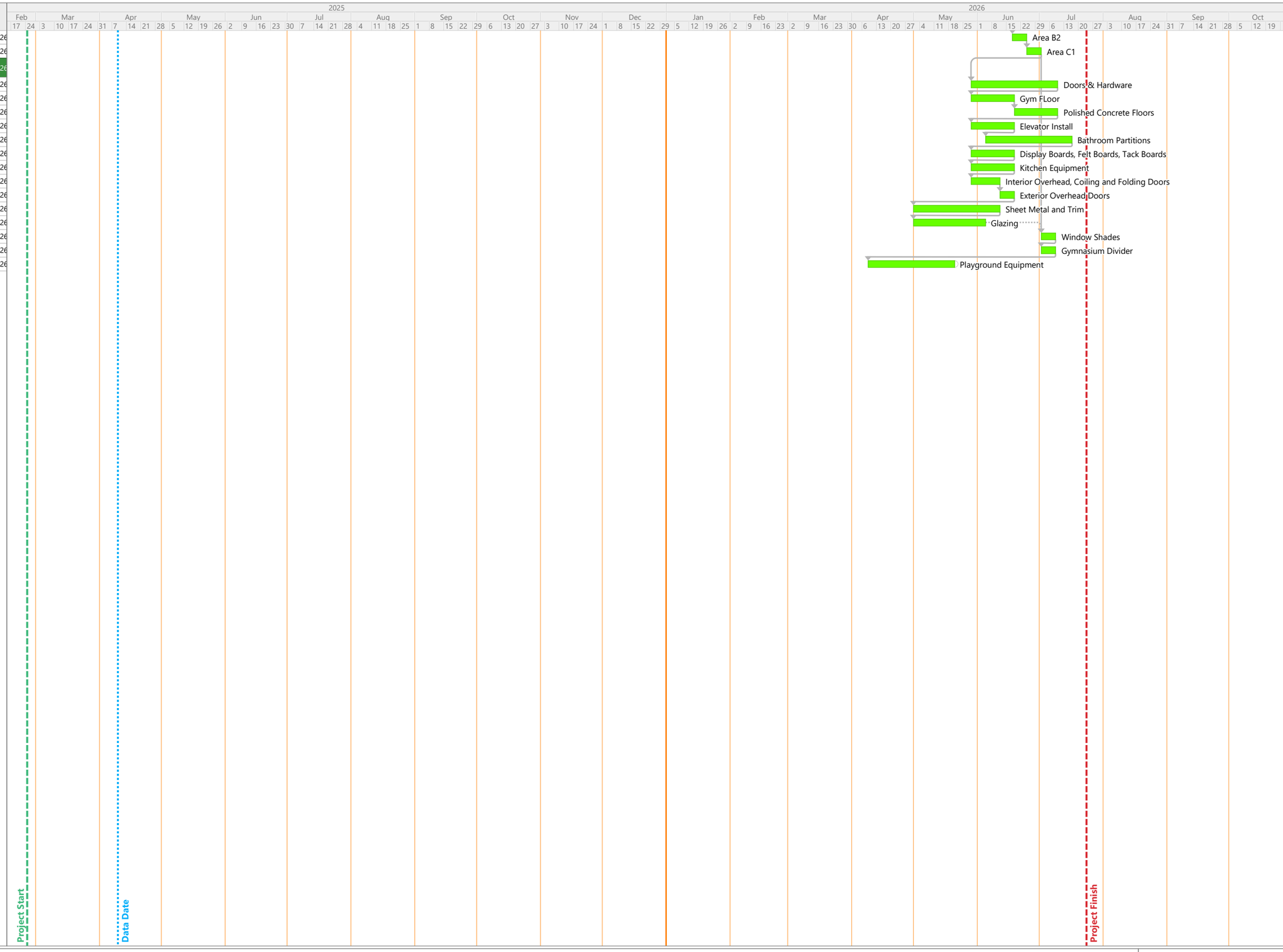


Start Date: 02/25/25
Finish Date: 07/23/26
Data Date: 04/10/25
Run Date: 03/20/25
Prebid Schedule.ppx

Preliminary Schedule
Schedule is subject to change

CONSTRUCTION INC.

ID	Description	Original Duration	Start	Finish
910	Area B2	5	06/18/26	06/24/26
920	Area C1	5	06/25/26	07/01/26
Other Finishes and Specialities		71	04/09/26	07/16/26
930	Doors & Hardware	30	05/29/26	07/09/26
940	Gym FLoor	15	05/29/26	06/18/26
950	Polished Concrete Floors	15	06/19/26	07/09/26
960	Elevator Install	15	05/29/26	06/18/26
970	Bathroom Partitions	30	06/05/26	07/16/26
980	Display Boards, Felt Boards, Tack Boards	15	05/29/26	06/18/26
990	Kitchen Equipment	15	05/29/26	06/18/26
1000	Interior Overhead, Coiling and Folding Do	10	05/29/26	06/11/26
1010	Exterior Overhead Doors	5	06/12/26	06/18/26
1020	Sheet Metal and Trim	30	05/01/26	06/11/26
1030	Glazing	25	05/01/26	06/04/26
1040	Window Shades	5	07/02/26	07/08/26
1050	Gymnasium Divider	5	07/02/26	07/08/26
1060	Playground Equipment	30	04/09/26	05/20/26



Start Date: 02/25/25
Finish Date: 07/23/26
Data Date: 04/10/25
Run Date: 03/20/25
Prebid Schedule.ppx

Preliminary Schedule
Schedule is subject to change

DM CONSTRUCTION INC.

SECTION 01 3300.01

NWL COPYRIGHT RELEASE FORM

1.01 COPYRIGHT RELEASE FORM

A. **In response to the contractor's (subcontractor's) request to utilize portions of the copyrighted electronic files produced by Naylor Wentworth Lund Architects for the Hyde Park Elementary School Project Located in Hyde Park, Utah, NAYLOR WENTWORTH LUND ARCHITECTS AGREES TO provide the electronic files and ALLOW SUCH usage for THE CONTRACTOR'S (SUBCONTRACTOR'S) convenience and use in the preparation of shop drawings, subject to the following terms and conditions:**

B. Our electronic files are compatible with: Autodesk Revit 2024 and AutoCad 2019. Naylor Wentworth Lund Architects (hereafter us/we/our) makes no representation as to the compatibility of these files with the Contractor's (Subcontractor's) [hereafter you/your] hardware or software.

C. The electronic files are for use only to aid you in producing your portion of this project. Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in the preparation of shop drawings for this project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against our firm, our officers, directors, employees, agents or subconsultants that may arise out of or in connection with your use of the electronic files.

D. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files.

E. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.

F. Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display. If present, any title blocks, and other references to Naylor Wentworth Lund Architects, our consultants, or our client, must be removed. Submitted drawings shown otherwise will be subject to rejection.
Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by us, and we make no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files.

G. You agree to pay us the sum of Two Hundred Fifty Dollars ($250.00) to cover administrative expenses associated with this request.

H. We will furnish you the following electronic files (please note which file(s) are being requested):
   1.
   2.
   3.
   4.
   5.

I. You agree to all of the conditions listed above by signing this document.

_____	Naylor Wentworth Lund Architects_____
Contractor (Subcontractor)	Architect
_____	_____
Signature	Signature
_____	_____
Printed Name and Title	Printed Name and Title
_____	_____
Date	Date

END OF SECTION 01 3300.01

SECTION 01 4219

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
B. Comply with the reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
C. Obtain copies of standards when required by Contract Documents.
D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Date of Substantial Completion.
E. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

END OF SECTION 01 4219

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SECTION 01 4300

QUALITY ASSURANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.
B. References and standards.
C. Testing and inspection agencies and services.
D. Control of installation.
E. Mock-ups.
F. Tolerances.
G. Manufacturers' field services.
H. Defect assessment.

1.02 RELATED REQUIREMENTS

A. AIA Document A201 - General Conditions: Inspections and approvals required by public authorities.
B. Section 01 3000 - Administrative Requirements: Submittal procedures.
C. Section 01 6000 - Product Requirements: Requirements for material and product quality.
D. Section 31 0000 - Geotechnical Investigation: Soil investigation data.

1.03 REFERENCE STANDARDS

A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2017.
C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.
D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2018.
F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
    1. Include:
        a. Date issued.
        b. Project title and number.
        c. Name of inspector.
        d. Date and time of sampling or inspection.

e. Identification of product and specifications section.
f. Location in the Project.
g. Type of test/inspection.
h. Date of test/inspection.
i. Results of test/inspection.
j. Compliance with Contract Documents.
k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
1. Submit report in duplicate within 30 days of observation to Architect for information.
2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.05 REFERENCES AND STANDARDS- SEE SECTION 01 4219

1.06 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
B. Contractor shall be responsible to schedule all specified testing and inspection.
C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
D. Contractor Employed Agency:
1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
4. Laboratory: Authorized to operate in the State in which the Project is located.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
B. Comply with manufacturers' instructions, including each step in sequence.
C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Have work performed by persons qualified to produce required and specified quality.
F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required,construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
C. Perform tests under provisions identified in this section and identified in the respective product specification sections.
D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
E. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
F. Use accepted mock-ups a a comparison standard for the remaining Work.
G. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.
B. Testing Agency Duties:
    1. Test samples of mixes submitted by Contractor.
    2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
    3. Perform specified sampling and testing of products in accordance with specified standards.

4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
6. Perform additional tests and inspections required by Architect.
7. Attend preconstruction meetings and progress meetings.
8. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
   a. To provide access to Work to be tested/inspected.
   b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
   c. To facilitate tests/inspections.
   d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect and Owner, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION 01 4300

SECTION 01 5000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities: Provision of electricity, lighting, heat, ventilation, and water.
B. Temporary telecommunications services.
C. Temporary sanitary facilities.
D. Temporary controls: Barriers, enclosures, and fencing.
E. Security requirements.
F. Vehicular access and parking.
G. Waste removal facilities and services.
H. Project identification sign.
I. Field offices.
J. Temporary fire protection.

1.02 TEMPORARY UTILITIES

A. Temporary Electricity:
    1. Cost: By Contractor.
    2. Cost: By Owner.
    3. Cost: By Owner. Abuse of this utility use will be subject to termination. At such time, the contractor would be responsible for providing temporary power to the project site at their own expense.
    4. Provide power service required from utility source.
    5. Connect to Owner's existing power service.
        a. Do not disrupt Owner's need for continuous service.
        b. Exercise measures to conserve energy.
    6. Power Service Characteristics: 208 volt, three phase, four wire / 120 volt, single phase.
    7. Complement existing power service capacity and characteristics as required.
    8. Provide power outlets for construction operations, with branch wiring and distribution boxes located at each floor and locations as required. Provide flexible power cords as required.
    9. Provide main service disconnect and over-current protection at convenient location and meter.
    10. Permanent convenience receptacles may be utilized during construction.
    11. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.
        a. Provide 20 ampere, duplex outlets, single phase for circuits for power tools.
        b. Provide 20 ampere, single phase branch circuits for lighting.
B. Temporary Lighting for Construction Purposes
    1. Provide and maintain incandescent lighting for construction operationsto achieve a minimum lighting level of 2 watts/sq ft.
    2. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
    3. Provide and maintain 0.25 watt/sq ft H.I.D. lighting to interior work areas after dark for security purposes.
    4. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

5. Maintain lighting and provide routine repairs.
6. Permanent building lighting may be utilized during construction.

C. Temporary Heating
1. Cost of Energy: By Contractor.
2. Cost of Energy: By Owner.
3. Cost: By Owner. Abuse of this utility use will be subject to termination. At such time, the contractor would be responsible for providing temporary power to the project site at his own expense.
4. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
5. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
6. Do not use existing facilities.
7. Owner's existing heat plant may be used.
8. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

D. Temporary Cooling
1. Cost of Energy: By Contractor.
2. Cost of Energy: By Owner.
3. Cost: By Owner. Abuse of this utility use will be subject to termination. At such time, the contractor would be responsible for providing temporary power to the project site at his own expense.
4. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
5. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
6. Do not use existing facilities.
7. Owner's existing cooling plant may be used.
8. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

E. Temporary Ventilation
1. Existing ventilation equipment may not be used.

F. Temporary Water Service
1. Cost of Water Used: By Contractor.
2. Cost of Water Used: By Owner.
3. Cost: By Owner. Abuse of this utility use will be subject to termination. At such time, the contractor would be responsible for providing temporary water to the project site at his own expense.
4. Provide and maintain suitable quality water service for construction operations at time of project mobilization.

G. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Ensure that telecommunications services include:

1. Windows-based personal computer dedicated to project tcommunications, with necessary software and printer.
2. Telephone Lines: One line, minimum (cellular phone).
3. Internet Connections: Continous highest speed available.
4. Printer: Ability to print on site.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
B. Maintain daily in clean and sanitary condition.
C. At end of construction, return facilities to same or better condition as originally found.

1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
C. Provide protection for plants designated to remain. Replace damaged plants.
D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING (IF REQUIRED)

A. Construction: Commercial grade chain link fence.
B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

A. Keep building enclosed and secure when not on site
B. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.09 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
B. Coordinate with Owner's security program.

1.10 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.
D. Provide means of removing mud from vehicle wheels before entering streets.
E. Designated existing on-site roads may be used for construction traffic.
F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.11 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
B. Provide containers with lids. Remove trash from site weekly.
C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.
B. Sign Materials:
    1. Structure and Framing: New, wood or metal, structurally adequate.
    2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints, painted white.
    3. Rough Hardware: Galvanized.
    4. Lettering: Exterior quality paint, contrasting colors.
C. Project Identification Sign:
    1. One painted sign, 32 square feet (3 square meters) area, bottom 6 feet (2 meters) above ground.
    2. Content:
        a. Project title, logo and name of Owner as indicated on Contract Documents.
        b. Names and titles of Architect and Consultants.
        c. Name of Prime Contractor and Major Subcontractors.
    3. Graphic design, colors, style of lettering: Designated by Architect.
D. Installation:
    1. Install project identification sign within 30 days after date fixed by Notice to Proceed.
    2. Erect at location of high public visibility, adjacent to main entrance to site.
    3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
    4. Install sign surface plumb and level, with butt joints. Anchor securely.
E. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES, JOB TRAILERS, AND MATERIAL STOCKPILE AREA

A. Coordinate with Governing Authorities, Owner, and neighboring properties.
B. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
C. Provide space for Project meetings, with table and chairs to accommodate 12 persons minimum.
D. Locate offices a minimum distance of 20 feet from existing and new structures.

1.14 TEMPORARY FIRE PROTECTION

A. Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with IFC 906, "Code for Portable Fire Extinguishers," and IBC Chapter 33 and IFC Chapter 14 "Fire Safety During Construction."
   1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor.
   2. Store combustible materials in containers in fire-safe locations.
   3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities. Prohibit smoking in hazardous fire exposure areas.
   4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

1.15 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
C. Clean and repair damage caused by installation or use of temporary work.
D. Restore existing facilities used during construction to original condition.
E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 5000

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SECTION 01 5713

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.
B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
C. Restoration of areas eroded due to insufficient preventive measures.
D. Performance bond.
E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.
F. Coordinate submittal of the S.W.P.P.P. with the owner.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete for temporary and permanent erosion control structures indicated on drawings.
B. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.
C. Section 32 1123 - Aggregate Base Courses: Temporary and permanent roadways.

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus; 2014 (Reapproved 2018).
B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2017.
C. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.; 1999a (Reapproved 2014).
D. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015.
E. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
F. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2020.
G. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
H. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
I. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2015.

1.04 PERFORMANCE REQUIREMENTS

A. Comply with requirements of EPA (NPDES) for erosion and sedimentation control, as specified by the NPDES, for Phases I and II, and in compliance with requirements of Construction General Permit (CGP), whether the project is required by law to comply or not.
B. Comply with requirements of State of Utah Erosion and Sedimentation Control Manual.
C. Runoff Calculation Standard for Urban Areas: USDA TR-55.
D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
   1. Obtain and pay for permits and provide security required by authority having jurisdiction.
   2. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
F. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
G. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
M. Open Water: Prevent standing water that could become stagnant.
N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Erosion and Sedimentation Control Plan:
   1. Submit within 2 weeks after Notice to Proceed.
   2. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided any additional information specified is also included.
   3. Obtain the approval of the Plan by authorities having jurisdiction.
   4. Obtain the approval of the Plan by Owner.
C. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
D. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
E. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mulch: Use one of the following:
   1. Straw or hay.
   2. Wood waste, chips, or bark.
   3. Erosion control matting or netting.
   4. Cutback asphalt.
   5. Polyethylene film, where specifically indicated only.
B. Bales: Air dry, rectangular straw bales.
   1. Cross Section: 14 by 18 inches, minimum.
   2. Bindings: Wire or string, around long dimension.
C. Bale Stakes: One of the following, minimum 3 feet long:
   1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
   2. Wood, 2 by 2 inches in cross section.
D. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
   1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
   2. Permittivity: 0.05 sec^-1, minimum, when tested in accordance with ASTM D4491/D4491M.
   3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
   4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.

5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
8. Manufacturers:
    a. TenCate: www.tencate.com.
    b. North American Green: www.nagreen.com.
    c. Propex Geosynthetics: www.geotextile.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

E. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
2. Softwood, 4 by 4 inches in cross section.
3. Hardwood, 2 by 2 inches in cross section.

F. Gravel: See Section 32 1123 for aggregate.

G. Concrete: See Section 03 3000.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: As required; 20 feet, minimum.
2. Length: 50 feet, minimum.
3. Provide at each construction entrance from public right-of-way.
4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.

C. Linear Sediment Barriers: Made of silt fences.
1. Provide linear sediment barriers:
    a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
    b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
    c. Along the toe of cut slopes and fill slopes.
    d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
    e. Across the entrances to culverts that receive runoff from disturbed areas.
2. Space sediment barriers with the following maximum slope length upslope from barrier:
    a. Slope of Less Than 2 Percent: 100 feet.
    b. Slope Between 2 and 5 Percent: 75 feet.
    c. Slope Between 5 and 10 Percent: 50 feet.
    d. Slope Between 10 and 20 Percent: 25 feet.
    e. Slope Over 20 Percent: 15 feet.

D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
   1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1 1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
   2. Straw bale row blocking entire inlet face area; anchor into pavement.
E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
G. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.
   2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
   1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
   2. Asphalt: Use only where no traffic, either vehicular or pedestrian, is anticipated.

3.04 INSTALLATION

A. Traffic-Bearing Aggregate Surface:
   1. Excavate minimum of 6 inches.
   2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
   3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
B. Silt Fences:
   1. Store and handle fabric in accordance with ASTM D4873/D4873M.
   2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
   3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
   4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
   5. Install with top of fabric at nominal height and embedment as specified.
   6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
   7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
   8. Fasten fabric to wood posts using one of the following:
      a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
      b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
   9. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
   10. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
C. Straw Bale Rows:
   1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
   2. Install bales so that bindings are not in contact with the ground.

3. Embed bales at least 4 inches in the ground.
4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
5. Fill gaps between ends of bales with loose straw wedged tightly.
6. Place soil excavated for trench against bales on the upslope side of the row, compacted.

D. Mulching Over Large Areas:
1. Dry Straw and Hay: Apply 2 1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
2. Wood Waste: Apply 6 to 9 tons per acre.
3. Asphalt: Apply at 1200 gallons per acre.
4. Erosion Control Matting: Comply with manufacturer's instructions.

E. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
2. Wood Waste: Apply 2 to 3inches depth.
3. Asphalt: Apply 1/4 gallon per square yard.
4. Erosion Control Matting: Comply with manufacturer's instructions.

3.05 MAINTENANCE

A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
B. Repair deficiencies immediately.
C. Silt Fences:
1. Promptly replace fabric that deteriorates unless need for fence has passed.
2. Remove silt deposits that exceed one-third of the height of the fence.
3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

D. Straw Bale Rows:
1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
2. Remove silt deposits that exceed one-half of the height of the bales.
3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

E. Clean out temporary sediment control structures weekly and relocate soil on site.
F. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
B. Clean out temporary sediment control structures that are to remain as permanent measures.
C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 01 5713

SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.
B. Transportation, handling, storage and protection.
C. Product option requirements.
D. Substitution limitations.
E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 1100 - Summary of Work: Lists of products to be removed from existing building, if applicable.
B. Section 01 4300 - Quality Assurance: Product quality monitoring.
C. Section 01 7413 - Progress Cleaning: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
    1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.
B. Use of products having any of the following characteristics is not permitted:
    1. Made using or containing CFC's or HCFC's.
    2. Made of wood from newly cut old growth timber.
    3. Containing lead, cadmium, or asbestos.
C. Where other criteria are met, Contractor shall give preference to products that:
    1. Are extracted, harvested, and/or manufactured closer to the location of the project.
    2. Have longer documented life span under normal use.
    3. Result in less construction waste. See Section 01 7413
D. Provide all Finish Material Products used in any individual system from the same manufacturer; no exceptions.

2.02 PRODUCT OPTIONS

A. In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, provide the better quality or greater quantity of work in accordance with the Architect's interpretation.
B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
C. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer or product not named.
E. Manufacturers other than Basis of Design Manufacturers shall provide products or systems that meet or exceed Basis of Design products or systems. Do not issue change order solely based on bid product or system not meeting Basis of Design and being rejected through submittal process.
F. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.03 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
    1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
    2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    3. Evidence that proposed product provides specified warranty.
    4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
    5. Samples, if requested.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES FOR APPROVAL PRIOR TO BIDDING

A. Architect will only consider requests for proposed substitutions made prior to 4 working
B. Proposed substitutions may be considered after this date when a product becomes unavailable through no fault of the Contractor.
C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
D. A request for substitution constitutes a representation that the submitter:
    1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
    2. Agrees to provide the same warranty for the substitution as for the specified product.

3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

E. Proposed substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Proposed Substitution Submittal Procedure:
1. Submit one electonic copy of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. Architect will notify Contractor in writing of decision to accept or reject request.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
D. Transport and handle products in accordance with manufacturer's instructions.
E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7413.
B. Store and protect products in accordance with manufacturers' instructions.
C. Store with seals and labels intact and legible.
D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
E. For exterior storage of fabricated products, place on sloped supports above ground.
F. Provide off-site storage and protection when site does not permit on-site storage or protection.
G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
H. Comply with manufacturer's warranty conditions, if any.
I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 6000

SECTION 01 7413

PROGRESS CLEANING

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.
B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
E. Methods of trash/waste disposal that are not acceptable are:
    1. Burning on the project site.
    2. Burying on the project site.
    3. Dumping or burying on other property, public or private.
    4. Other illegal dumping or burying.
F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
H. Recycling: The process of sorting, cleansing, treating, and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
I. Return: To give back reusable items or unused products to vendors for credit.
J. Reuse: To reuse a construction waste material in some manner on the project site.
K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
    1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
    2. Submit Report on a form acceptable to Owner.
    3. Landfill Disposal: Include the following information:
        a. Identification of material.
        b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
        c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
        d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    4. Incinerator Disposal: Include the following information:
        a. Identification of material.
        b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
        c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
        d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    5. Recycled and Salvaged Materials: Include the following information for each:
        a. Identification of material, including those retrieved by installer for use on other projects.
        b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
        c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
        d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
        e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
    6. Material Reused on Project: Include the following information for each:
        a. Identification of material and how it was used in the project.
        b. Amount, in tons or cubic yards.
        c. Include weight tickets as evidence of quantity.
    7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.
C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.
D. See Section 01 7700 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
D. Meetings: Discuss trash/waste management goals and issues at project meetings.
    1. Prebid meeting.
    2. Preconstruction meeting.
    3. Regular job-site meetings.
E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
    1. Provide containers as required.
    2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
    3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 01 7413

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SECTION 01 7700

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Starting of systems and equipment.
H. Demonstration and instruction of Owner personnel.
I. General requirements for maintenance service.
J. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
K. Closeout submittals, including:
    1. Project record documents.
    2. Operation and maintenance data.
    3. Warranties, guarantees, and bonds.
        a. Form of Guarantee/Warranty follows as:
            1) Section 01 7801 - Form of Guarantee/Warranty
L. Samples for AIA documents required are included and follow this Section:
    1. AIA G704 Certificate for Substantial Completion.
    2. AIA G706 Contractor's Affidavit of Payment of Debts and Claims.
    3. AIA G706A Contractor's Affidavit of Release of Liens.
    4. AIA G707 Consent of Surety Company to Final Payment.

1.02 RELATED REQUIREMENTS

A. Section 00 7300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
B. Section 01 1100 - Summary of Work: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
C. Section 01 3000 - Administrative Requirements: Submittals procedures, electronic document submittal service, shop drawings, product data, and samples.
D. Section 01 4300 - Quality Assurance: Testing and inspection procedures.
E. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
F. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.
G. Section 01 5100 - Temporary Utilities: Temporary heating, cooling, and ventilating facilities.
H. Section 01 5713 - Temporary Erosion and Sediment Control: Additional erosion and sedimentation control requirements.
I. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, guaranties, warranties and bonds.
J. Section 00 6536 - Warranty Form.
K. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

L. Section 02 4100 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.
M. Section 07 8400 - Firestopping if used.
N. Individual Product Specification Sections:
    1. Advance notification to other sections of openings required in work of those sections.
    2. Limitations on cutting structural members.
    3. Specific requirements for operation and maintenance data.
    4. Warranties/Guarantees required for specific products or Work.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
    1. On request, submit documentation verifying accuracy of survey work.
    2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
    3. Submit surveys and survey logs for the project record.
C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
    1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
    2. Identify demolition firm and submit qualifications.
    3. Include a summary of safety procedures.
D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
    1. Structural integrity of any element of Project.
    2. Integrity of weather exposed or moisture resistant element.
    3. Efficiency, maintenance, or safety of any operational element.
    4. Visual qualities of sight exposed elements.
    5. Work of Owner or separate Contractor.
    6. Include in request:
        a. Identification of Project.
        b. Location and description of affected work.
        c. Necessity for cutting or alteration.
        d. Description of proposed work and products to be used.
        e. Effect on work of Owner or separate Contractor.
        f. Written permission of affected separate Contractor.
        g. Date and time work will be executed.
E. Project Record Documents:
    1. Accurately record actual locations of capped and active utilities.
    2. Submit documents to Architect with claim for final Application for Payment.
F. Operation and Maintenance Data:
    1. Submit a PDF file of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return with comments.
    2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.

3. Submit a PDF file of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
4. Submit two hard copy sets and one set on USB storage device of revised final documents in final form within 10 days after final inspection.

G. Warranties, Guarantees, and Bonds:
1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

1.05 QUALIFICATIONS

A. For demolition work, employ a firm specializing in the type of work required.
1. Minimum of 3 years of documented experience.

B. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.06 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
1. Minimize amount of bare soil exposed at one time.
2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Limit conduct of especially noisy interior/exterior work to hours approved by Cache County School District.

H. Pest and Rodent Control: Provide methods, means, and facilities to:
   1. Prevent pests and insects from damaging the work.
   2. Prevent rodents from accessing or invading premises.

I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. See Section 01 1100 for occupancy-related requirements.
B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
C. Notify affected utility companies and comply with their requirements.
D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
G. Coordinate completion and clean-up of work of separate sections.
H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.

5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.
C. Store record documents separate from documents used for construction.
D. Record information concurrent with construction progress.
E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.
F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
B. Additional information as specified in individual product specification sections.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
B. Include color coded wiring diagrams as installed.
C. Provide control diagrams by controls manufacturer as installed.
D. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
E. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
F. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
G. Include test and balancing reports.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Binders: Commercial quality, 8 1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
B. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
C. Dividers: Provide tabbed dividers for each separate product and system; identify the Section Number on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
C. Examine and verify specific conditions described in individual specification sections.
D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.07 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.
B. Seal cracks or openings of substrate prior to applying next material or substance.
C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.08 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
B. Require attendance of parties directly affecting, or affected by, work of the specific section.
C. Notify Architect four days in advance of meeting date.
D. Prepare agenda and preside at meeting:
    1. Review conditions of examination, preparation and installation procedures.
    2. Review coordination with related work.
E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.09 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.
B. Promptly notify Architect of any discrepancies discovered.
C. Contractor shall locate and protect survey control and reference points.
D. Control datum for survey is that established by Owner provided survey.

E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
H. Utilize recognized engineering survey practices.
I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
    1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
    2. Grid or axis for structures.
    3. Building foundation, column locations, ground floor elevations, etc.
    4. Building wall locations, door and window opening locations, etc.
    5. Assist subcontractors relative to layout and coordination of their work to successfully complete the project.
K. Construction Related Services: The Contractor will provide construction related services including construction staking, site visits, weekly construction meetings, and shop drawings review.
    1. Construction staking will include the following:
        a. Stake rough grade.
        b. Blue top pads.
        c. Red top street, parking lot subgrade.
        d. Provide sewer stakes.
        e. Provide water line and fire hydrant stakes.
        f. Provide power installation stakes.
        g. Stake curb and gutter.
        h. Blue top street and parking lot finished gravel.
        i. Stake property corners.
        j. Stake finish grades at playfields and landscape areas per Civil Engineers requirements.
L. Periodically verify layouts by same means.
M. Maintain a complete and accurate log of control and survey work as it progresses.

3.10 GENERAL INSTALLATION REQUIREMENTS

A. Provide or Install means Contractor shall: Furnish all labor, materials, equipment, tools and services required to fully complete installation of specified work as is indicated on the drawings and/or specifications.
B. Install products as specified in individual sections, in accordance with manufacturer's printed instructions and recommendations, and so as to avoid waste due to necessity for replacement.
C. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
D. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
E. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
F. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
G. Make neat transitions between different surfaces, maintaining texture and appearance.

3.11 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
   2. Remove items indicated on drawings.
   3. Relocate items indicated on drawings.
   4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
      a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
      b. See Section 01 1100 for other limitations on outages and required notifications.
      c. Provide temporary connections as required to maintain existing systems in service.
   4. Verify that abandoned services serve only abandoned facilities.
   5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.

3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
   1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
   2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
   3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
   4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.12 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:

1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
2. Match color, texture, and appearance.
3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.13 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
D. Collect and remove waste materials, debris, and trash/rubbish from site weekly and dispose off-site; do not burn or bury.

3.14 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.
B. Provide special protection where specified in individual specification sections.
C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
G. Prohibit traffic from landscaped areas.
H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.15 SYSTEM STARTUP

A. Coordinate with requirements of Individual Specification Sections.
B. Coordinate schedule for start-up of various equipment and systems.
C. Notify Architect and Owner seven days prior to start-up of each item.
D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
F. Verify that wiring and support components for equipment are complete and tested.
G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
I. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.16 DEMONSTRATION AND INSTRUCTION

A. See Section 01 7900 - Demonstration and Training.

3.17 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.
B. Testing, adjusting, and balancing HVAC systems: See Division 23.

3.18 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
    1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
B. Use cleaning materials that are nonhazardous.
C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
F. Replace filters of operating equipment.
G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems as needed
H. Clean site; sweep paved areas, rake clean landscaped surfaces.
I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.19 CLOSEOUT PROCEDURES

A. State Fire Marshal's Certificate of Fire Clearance:
    1. Inspections will be limited to a 70 Percent Completion Inspection and a Final Completion Inspection. However, State Fire Marshal personnel do conduct additional "construction-in-progress" inspections, and it is rare that a final inspection consists of only one visit to the project. It is most important that the Architect, Contractor, Representatives for Cache County School District and the Local Fire Department be present for the 70 Percent Completion Inspection. To this is added all appropriate subcontractors for the Final Completion Inspection.
    2. 70 Percent Completion Inspection:
        a. The State Fire Marshal's Office will check all of, but not limited to the following:
            1) Fire department access.
            2) Fire hydrant placement and operation.
            3) Fire walls (areas and/or occupancy separation; complete to the deck: penetrations, dampers, etc.)
            4) Exiting (any obstructions).
            5) Sprinkler piping, risers, stand pipes and hydrostatic tests.
            6) Certificates of underground piping tests.
            7) Door and window frames (ratings).
            8) Insulation and coverings.
            9) Wood usage in structure (non-combustible).
            10) Fireproofing and/or firestopping.
            11) Penetrations of structure (non-combustible).
            12) Impediments.
            13) Heating procedure (fuel location and piping).
            14) Welding and cutting procedures.
            15) Roofing procedures; roofing materials.

3. Final Completion Inspection:
    a. Prior to requesting the Final Completion Inspection, the Contractor shall complete the following:
        1) Assure that the project is complete and ready for inspection.
        2) Perform a complete test of the fire alarm, fire protection, and life safety systems. Coordinate this test with the Architect and Cache County School District prior to scheduling the Final Completion Inspection. The electrical, fire alarm, and fire protection subcontractors shall be present at this test. Repeat this test until all elements of the test are acceptable. Refer to Section 01 4000 for testing requirements.
            (a) The Contractor shall perform a complete test of the fire sprinkler system noting coverage, and completeness of the riser. The fire alarm system is completely checked for operation and adequate coverage. This also includes the 24 hour battery test. Emergency lighting and exit signs as well as door operation and hardware are also checked. The mechanical systems are inspected and hood fire suppression system is also inspected and tested, including fire alarm tie-in and fuel shut-offs (if required). Inspect and text the Proscenium Fire Curtain and all special doors such as roll-up doors or horizontal folding doors. Also ensure that appropriate certificates, where applicable, have also been obtained.
        3) Provide a Key Plan, showing fire alarm zones and the fire sprinkler plan, installed next to the fire alarm control panel to aid the local fire department if there is a fire in the building.
    b. The State Fire Marshal's office will generate a written Final Inspection Report and send it to the Project Architect. The Certificate of Fire Clearance will only be issued after all fire and life safety items previously listed as deficient are resolved appropriately.
        1) No occupancy is permitted without the State Fire Marshal's Certificate of Fire Clearance.

B. Certificate of Substantial Completion:
    1. Pre-Substantial Completion Observation:
        a. Before requesting the Substantial Completion Observation, complete the following:
            1) Prepare a Punch List of outstanding items and deficiencies to be completed.
            2) Complete all items on the Punch List.
            3) Submit the completed Punch List to the Architect with verification that it has been completed.
            4) Provide completed Closeout Submittals as specified in Section 01 7800.
            5) Advise Cache County School District of any pending insurance change-over requirements.
            6) Deliver maintenance stock items to Cache County School District.
            7) Conduct Owner demonstration and instruction for all systems as specified in Section 01 7900.
            8) Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements as specified in Section 01 5000.
            9) Complete final clean up requirements, touch-up and otherwise repair and restore marred exposed finishes.
    2. Substantial Completion Observation:
        a. The State Fire Marshal's Office should, if acceptable, deliver to Cache County School District the Certificate of Fire Clearance. (Original to follow in the mail.)

1) The Owner may not occupy the building until the Certificate of Fire Clearance has been signed.

b. The Date of Occupancy must be agreed to by the appropriate Building Official who will issue the Occupancy Permit.
c. The Architect will prepare a Punch List of items remaining to be finished.
d. Architect's Consultants (Electrical, Mechanical, Civil, Kitchen, Landscape, etc) will prepare a Punch List of items remaining to be finished.
   1) Landscape Observation may be scheduled for a separate date.
e. The Substantial Completion Observation requires the participation of the following:
   1) General Contractor.
   2) Electrical Contractor.
   3) Temperature Control Contractor.
   4) Fire Alarm Contractor.
   5) Fire Protection Sprinkler Contractor.
   6) Mechanical Contractor.
   7) Test and Balance Contractor (with completed test and balance report).
   8) Food Service Equipment Contractor.
   9) Elevator Contractor.
   10) Platform Curtain and Rigging Contractor.
   11) Landscape Contractor.
   12) In addition to the above participants, the following persons shall attend:
      (a) School District Representative.
      (b) Building Inspectors.
      (c) Representative of the State Fire Marshal's Office (if required).
      (d) Architect.
      (e) Project Engineers and Consultants.
   13) Coordinate attendance OF ALL the above listed subcontractors, and the Architect will coordinate the remainder as required.
f. Observation Procedures: On receipt of a request for this Observation, the Architect will either proceed with the same or advise the Contractor of unfulfilled requirements. The Architect will prepare the Certificate of Substantial Completion following this Observation, or advise the Contractor of work that must be completed or corrected before the certificate will be issued.
   1) The Architect will repeat the Observation only when assured that the Work has been substantially completed.
   2) Results of this Observation will form the basis of requirements for final acceptance.
g. When the Substantial Completion Certificate is awarded, be prepared to obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities.
   1) AIA Document G706, Contractor's Affidavit of Payment of Debts and Claims.
   2) AIA Document G706A, Contractor's Affidavit of Release of Liens.
   3) AIA Document G707, Consent of Surety Company to Final Payment.

C. Final Acceptance Observation:
   1. Before requesting Final Acceptance Observation for certification of final acceptance and final payment, complete the following:
      a. Submit the final payment request and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
      b. Submit an updated final statement accounting for final additional changes to the Contract Sum.

c. Submit a certified copy of the Architect's final observation list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance.
d. Submit AIA Document G707 Consent of Surety Company to Final Payment.
e. Submit a final liquidated damages settlement statement.
f. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

2. Re-Observation Procedure: The Architect will re-observe the Work upon receipt of notice that the Work, including observation list items from earlier observations, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect.
   a. Upon completion of this observation, the Architect will advise the Contractor the project is acceptable and to proceed with final project closeout as listed above, or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
   b. If necessary, the Architect will conduct additional re-observations as required to obtain final acceptance. Each subsequent re-observation will be back charged against the project Contract for the Architect's, Engineer's, and Owner's time.

D. Proposed Time Schedule:
   1. The Architect is suggesting the following dates for Project Closeout. These dates are to be considered latest possible dates to meet the Owner's requirements. Earlier dates are preferred.
      a. Date to be announced - Fire Marshal 70% Inspection
      b. Date to be announced - Substantial Completion Observation and Fire Marshal Observation.
      c. Date to be announced - Final Acceptance Observation.
E. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.
F. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
G. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
H. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
I. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

3.20 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.
B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service cannot be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 7700

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SECTION 01 7800

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.
B. Operation and maintenance data.
C. Warranties, guarantees, and bonds.
    1. Form of Guarantee/Warranty follows as:
        a. Section 01 7801 - Form of Guarantee/Warranty.

1.02 RELATED REQUIREMENTS

A. Section 00 7300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
B. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
C. Section 01 7700 - Closeout Procedures: Contract closeout procedures.
D. Section 00 6536 - Warranty Form
E. Individual Product Sections: Specific requirements for operation and maintenance data.
F. Individual Product Sections: Warranties/Guarantees required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
B. Operation and Maintenance Data:
    1. Submit a PDF file of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return with comments.
    2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
    3. Submit a PDF file of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
    4. Submit two hard copy sets and one set on USB storage device of revised final documents in final form within 10 days after final inspection.
C. Warranties, Guarantees, and Bonds:
    1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
    2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
    3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed shop drawings, product data, and samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.
C. Store record documents separate from documents used for construction.
D. Record information concurrent with construction progress.
E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.
F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For each product, applied material, and finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.
B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
D. Additional information as specified in individual product specification sections.
E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.

P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8 1/2 by 11 inch three D side ring binders with durable plastic covers; 3 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractorand subcontractors, with names of responsible person.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
   1. Tabs to organized by Section Number.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the Section Number on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
H. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.06 WARRANTIES, GUARANTEES, AND BONDS

A. Each Subcontractor to submit form found in Section 00 6536 - Warranty Form
B. Minimum Guarantee/Warranty period to be One (1) unless otherwise stated in Sections.
C. Obtain warranties, guarantees, and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
D. Verify that documents are in proper form, contain full information, and are notarized.
E. Co-execute submittals when required.
F. Retain warranties and bonds until time specified for submittal.
G. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
H. Manual: Bind in commercial quality 8 1/2 by 11 inch three D side ring binders with durable plastic covers.
I. Cover: Identify each binder with typed or printed title WARRANTIES, GUARANTEES, AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
J. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
K. Separate each warranty, guarantee, or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 7800

SECTION 01 7900

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems where indicated in specific specification sections.
B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Conveying systems.
   6. Landscape irrigation.
   7. Food service equipment.
   8. Door hardware.
   9. Items specified in individual product Sections.
C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
   1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
   2. Finishes, including flooring, wall finishes, ceiling finishes.
   3. Fixtures and fittings.
   4. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Architect for transmittal to Owner.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.

2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
1. Identification of each training session, date, time, and duration.
2. Sign-in sheet showing names and job titles of attendees.
3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

E. Video Recordings (if requested by the owner): Submit digital video recording of each training session for Owner's subsequent use.
1. Format: USB flashdrive.
2. Label each disc and container with session identification and date.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
B. Demonstration may be combined with Owner personnel training if applicable.
C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.
2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Conduct training on-site unless otherwise indicated.
B. Owner will provide classroom and seating at no cost to Contractor.
C. Provide training in minimum two hour segments.
D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.
2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
3. Typical uses of the O&M manuals.

F. Product- and System-Specific Training:
1. Review the applicable O&M manuals.
2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
4. Provide hands-on training on all operational modes possible and preventive maintenance.
5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 7900

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SECTION 03 1000

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Concrete Forming work as required by the Drawings and/or specified herein including, but not limited to, the following described items.
B. Formwork for cast-in-place building concrete, with shoring, bracing and anchorage.
   1. Architectural-grade finishes for all exposed walls.
C. Openings for other work.
D. Form liner.
E. Form accessories.
F. Expanded polystyrene (EPS) geofoam void filler.
G. Form stripping.
H. Form work for cast-in-place site concrete walls, with shoring, bracing, and anchorage.
   1. Architectural grade finish for exposed site walls.
I. Do not include sales tax, refer to 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing.
B. Section 03 3000 - Cast-in-Place Concrete.
C. Section 03 4713 - Tilt-Up Concrete.
D. Section 04 2731 - Engineered Unit Masonry: Reinforcement for engineered masonry.
E. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
F. Section 05 2100 - Steel Joist Framing: Placement of embedded steel anchors, plates and joist seats in cast-in-place concrete.
G. Section 05 3100 - Steel Decking: Placement of steel anchors in composite decking.
H. Section 31 2316 - Excavation: Shoring and underpinning for excavation.

1.03 REFERENCE STANDARDS

A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
B. ACI 301 - Specifications for Concrete Construction; 2020.
C. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
D. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).
E. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2018, with Editorial Revision.
F. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
H. ASTM D6817/D6817M - Standard Specification for Rigid Cellular Polystyrene Geofoam; 2017 (Reapproved 2021).
I. ICC-ES AC239 - Acceptance Criteria for Termite-Resistant Foam Plastic; 2008, with Editorial Revision (2014).
J. PS 1 - Structural Plywood; 2009 (Revised 2019).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on form and void filler materials, form release compounds, form ties and installation requirements.
C. Shop Drawings: Submit formwork and shoring shop drawings. Indicate the following:
    1. Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
    2. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
    3. Means of leakage prevention for concrete exposed to view in finished construction.
    4. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift and height of drop during placement.
    5. Vertical, horizontal, and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
    6. Notes to formwork Erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
    7. EPS Geofoam void filler block layout.
D. Design Data: As required by authorities having jurisdiction.
    1. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
    2. Means of leakage prevention for concrete exposed to view in finished construction.
    3. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift and height of drop during placement.
    4. Vertical, horizontal, and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
    5. Notes to formwork Erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.
    6. EPS Geofoam void filler block layout.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.
B. Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.06 MOCK-UP

A. Locate mock-up where directed.
B. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store all form materials and accessories above ground on framework or blocking. Cover form materials with a suitable waterproof covering that provides adequate air circulation and ventilation.
B. Handling: Lift form panels by methods that will protect panels from damage and distortion.
C. Deliver EPS Geofoam void filler labeled with material type. Store above ground and protected from moisture and sunlight prior to installation. Product should not be exposed to open flame or other ignition sources.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

A. Formwork Standards: Unless otherwise indicated, design, construct, erect, maintain, and remove forms and related structures for concrete work in accordance with applicable requirements of ACI 301, ACI 318, and ACI 347.
   1. Architectural Concrete: Ensure that forms for architectural concrete are designed and constructed in accordance with ACI 301.
   2. Deflection: Where dead and live loads on forms will be more than 20 percent greater than the weight of the concrete, provide framing lumber of required strength, and comply with ACI 301 and ACI 347 for design of framing members. Keep deflection within the specified tolerances herein.
   3. Concrete Mix Design: Coordinate design of formwork with the concrete mix design as specified in Section 03 3000 - Cast-In-Place Concrete so that form materials, form surfaces, and formwork strength will produce the desired concrete tolerances and finishes.

B. Formwork Surface Materials: Provide material and work quality which will produce clean, smooth, and uniform finished surfaces within the allowable tolerances specified and which will conform with the following requirements:
   1. Concrete Exposed to View: Provide material and work quality that will produce clean, smooth, and uniform concrete surfaces. Transfer of wood grain to concrete is not acceptable. Refer to Section 03 3000 - Cast-In-Place Concrete and ACI 301 for requirements.
   2. Concrete Concealed from View: Provide material and work quality that will produce aligned concrete surfaces free of fins, honeycomb, and stains.

C. Special Formwork Sections: Provide openings, offsets, sinkages, keyways, recessed, moldings, rustication strips, chamfers, blocking, screeds, bulkheads, anchorages, embedded items, and other features. Select materials and provide workmanship that will ensure indicated finishes.

D. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.

E. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.

F. Chamfered Corners: Ensure that all outside corners of beams, joists, columns, and walls are chamfered unless otherwise indicated.

G. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

H. Comply with relevant portions of ACI 301, ACI 318, ACI 347R, ACI 301, ACI 318, ACI 347R, ACI 301, ACI 318, and ACI 347R.

I. Removal Features: Design formwork to be readily removable without impact, shock, and damage to concrete surfaces and adjacent materials.

J. Tolerances for Formed Surfaces: For buildings and similar structures, comply with the requirements of ACI 301, as applicable. For those items of work or parts of the structure not covered by ACI 301, comply with the requirements of ACI 117, as applicable. Coordinate with the requirements specified in Section 03 3000 - Cast-In-Place Concrete.

2.02 WOOD FORM MATERIALS

A. Softwood Plywood Forms: Ensure that plywood is graded and grade-marked in accordance with U.S. Product Standard PS 1.
   1. B-B Plyform: Provide Class I, EXT-APA, sanded, APA trademarked.
   2. B-C Plyform: Provide Class I, EXT-APA, APA trademarked.

3. High Density Overlay (HDO) Plyform: Provide A-A, 60-60, Class I, EXT-APA, APA trade marked.
4. Thickness: As required to maintain surface smoothness without deflection, but no thinner than 5/8 inch (16 mm).

B. Lumber Forms: Douglas Fir species; No. 2 grade; with grade stamp clearly visible.
1. Boards: Use dressed side of lumber for surface in contact with the concrete, and provide boards with shiplapped or tongue and groove edges to prevent mortar leakage.

C. Framing, Studding and Bracing Lumber: Stud or No. 2 structural light framing grade.

2.03 REMOVABLE PREFABRICATED FORMS

A. Manufacturers:
1. Symons - Dayton Superior Corporation: www.symons.com.
2. Advance Concrete Form, Inc: www.advanceconcreteform.com.
3. EFCO Corporation: www.efcoforms.com.
4. Western Forms: www.westernforms.com.

B. Preformed Steel Forms: Fabricated steel forms, using standard or commercial quality, uncoated steel sheet or plate, 3/16 inch (5 mm) minimum thickness, for panel facings. Provide surfaces that will not impart corrosion residue to concrete. Include panel framing, reinforcement, and erection accessories.

C. Form Liner: Tight-fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces. Refer to drawing for limited locations.
1. Pattern: Basis of Design: US Formliner pattern # 2/163 Fraser.

2.04 FORMWORK ACCESSORIES

A. Leakage Control Materials: Provide materials capable of producing flush, watertight, and non-absorbent surfaces and joints, and compatible with forming material and concrete ingredients. Seal form edges with gasketing material or sealant placed in the joint in such a way that neither a fin nor groove is made in the face of the cast concrete.
1. Caulking Compound: Silicone or polyurethane construction sealant conforming to ASTM C1184 or ASTM C920, as applicable.
2. Tapes: Form film tape of polypropylene plastic treated with waterproof adhesive, for joint conditions not exposed to view.

B. Form Release Agent: Commercial formulation, designed for use on all types of forms, capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, and not requiring removal for satisfactory bonding of coatings to be applied.

C. Form Ties: Rod type, with ends of end fasteners which can be removed without spalling the concrete and which leave a hole equal in depth to the required reinforcement clearance. Ensure that form ties are of a design in which the hole left by the removed end or end fastener is easily filled to match the surface of the hardened concrete. Provide removable cones 1 1/4 inches (32 mm) in diameter by 1 1/2 inches (38 mm) deep. Provide preformed mortar plugs to match the color of the concrete, recessed 1/4 inch (6 mm), adhered with an approved epoxy adhesive.

D. Inserts: Cast stainless steel or welded stainless steel, Type 316 or similar 300 Series, complete with anchors to concrete and fittings such as bolts, wedges, and straps. Provide hanger inserts where detailed.

E. Filler Strips for Chamfered Corners: Rigid plastic or wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.

F. Dovetail Anchor Slot: Galvanized steel, at least 22 gauge, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

G. Flashing Reglets: Galvanized steel, at least 22 gauge, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
H. Vapor Retarder: As specified in Section 03 3000.
I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
J. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 1200.
K. Waterstops: As specified in Section 03 3000.
L. Joint Filler: As specified in Section 32 1313.

2.05 EPS GEOFOAM VOID FILLER

A. Manufacturers:
   1. ACH Foam Technologies, LLC: www.achfoam.com.
   2. Big Sky Insulations, Inc: www.bigskyrcontrol.com.
   3. Insulfoam: www.insulfoam.com.
   4. Substitutions: See Section 01 6000 - Product requirements.
B. EPS Geofoam: Expanded polystyrene (EPS) geofoam void filler in accordance withASTM D6817/D6817M
   1. Type: EPS12 - 320 PSF - .70 LB/FT³.
   2. Use modified raw materials containing a flame retardant.
   3. Ensure that all Geofoam blocks are treated by the manufacturer with a tested and proven termite treatment for below grade applications and who has a minimum of three years' field exposure. Ensure that the treatment is EPA registered, meets requirements of ICC-ES AC239, and is recognized in an ICC ES report.
C. Gripper Plates: Galvanized or stainless steel with two-sided multi-barbed design capable of piercing geofoam. Ensure that each plate is capable of a lateral holding strength of 60 lbs.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 EARTH FORMS

A. Refer to structural notes.

3.03 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301 and approved Shop Drawings, and in a manner that will produce finished concrete surfaces conforming to indicated design and within specified tolerances.
B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads. Support joints with extra studs or girts, and in a manner that will ensure true, square intersections.
C. Brace temporary closures to prevent warpage or displacement and set tightly against forms in a manner that will prevent loss of concrete mortar.
D. Kerf wood inserts for forming keyways, reglets, and recesses in a manner that will prevent swelling and ensure ease of removal.
E. Construct molding shapes, recesses, and projections with smooth finish materials and install in forms with sealed joints.

F. Maintain forms clean and free from indentations and warpage. Do not use rust-stained steel surfaces for forms in contact with concrete. Do not sandblast steel form surfaces to remove rust or mill scale; remove these imperfections by grinding.
G. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
H. Make joints and and seams mortar-tight. Install leakage control materials in accordance with the manufacturer's installation instructions, and in a manner that will maintain a smooth continuity of plane between abutting form panels and which will resist displacement by concreting operations.
I. Provide camber in formwork as required to compensate for deflections caused by weight and pressures of fresh concrete and construction loads and as otherwise indicated. Provide camber strips to compensate for deflections due to permanent loads and long-term deflections due to shrinkage and creep as required.
J. Ensure that formed stair risers within a stair are equal.
K. Edge Forms and Screed for Slabs: Set edge forms or bulkheads and intermediate screeds for slabs to obtain required elevations and contours in the finished slab surface. Support screeds substantially without penetrating waterproof membranes and vapor barriers.
L. Corner Treatment: Form chamfers with 3/4 inch (19 mm) on each leg, unless otherwise indicated, and accurately shape and surface in a manner which will produce uniformly straight lines and edge joints and which will prevent mortar runs. Extend terminal edges to limits, and miter chamfer strips at changes in direction.
M. Construction Joints:
    1. Locate joints as indicated. Support forms for joints in concrete so as to rigidly maintain their positions during placement, vibration, and curing of concrete. Install keys in all joints.
    2. Locate and install construction joints, for which locations are not indicated, so as not to impair strength and appearance of structure, and indicate such joints on Shop Drawings. Locations of construction joints will require approval of the Engineer.
    3. Position joints perpendicular to longitudinal axis of pier, beam or slab as the case may be.
    4. Locate joints in walls, vertically as indicated; at top of footing; at top of slabs on grade; at bottom of door openings; and at underside of the deepest beam or girder framing into wall; or as required to conform to indicated details.
    5. Provide keyways as indicated in construction joints in walls and slabs, and between walls and footings unless otherwise indicated. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
N. Load Supports: Carry loads for construction of suspended floor slabs down to on-grade base slabs. Ensure that these loads are not carried by intermediate slabs at any time. Ensure that formwork loads are only carried by structural elements that are supported directly by footings.
O. Obtain approval before framing openings in structural members that are not indicated on drawings.
P. Install EPS Geofoam void filler and gripper plates in accordance with manufacturer's recommendations and structural requirements. Protect from moisture or crushing.
Q. Coordinate this section with other sections of work that require attachment of components to formwork.
R. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.
B. Locate and set in place items that will be cast directly into concrete.
C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 04 2113.
E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING AND RE-USE

A. Clean forms as erection proceeds, to remove foreign matter within forms.
B. Clean formed cavities of debris prior to placing concrete.
    1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
    2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.
C. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable. Remove such material from the site. Apply form release coating as specified for new formwork.
D. Align and secure joints in a manner that will preclude offsets. Do not use patched forms for exposed concrete surfaces.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.
B. Camber slabs and beams 1/4 inch per 10 feet.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4300 - Quality Assurance.
B. Before placing concrete, check lines and grades of erected formwork and positioning of embedded inserts, blockouts, and joints for correctness. Verify that embedded piping and conduit are free from obstruction. Make corrections or adjustments to ensure proper size and location of concrete members and stability of forming systems.
C. While placing concrete, provide quality control to assure that formwork and related supports have not been displaced, that loss of cement paste through joints is prevented, and that completed work will be with specified tolerances.
D. During form removal, verify that architectural features meet form and texture requirements.

E. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.09 DETECTION OF MOVEMENT

A. Check movement using methods, such as plumb lines, tell tales, and survey equipment, to detect movement of formwork during concrete placement.

3.10 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
B. Remove forms by methods which will not injure, mar, gouge, or chip concrete surfaces, overstress concrete members, or distort formwork. Use air pressure or other approved methods. Do not pry against concrete. Cut off nails flush. Leave surfaces clean and unblemished.
C. When repair of surface defects or finishing is required at an early age, forms may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations and its own weight.
    1. Repair concrete work that has been damaged by removal operations as specified in Section 03 3000 - Concrete. Where exposed surfaces are damaged beyond acceptable repairing measures, remove the damaged concrete and repair with new concrete.
D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
E. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION 03 1000

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work included: Provide all labor, materials, equipment, fabrication, incidentals, transportation, placing and supervision necessary to complete all cast-in-place concrete work, its finishing, and all related work called for by the Contract Drawings and/or Specifications, or reasonably inferable from either or both, as needed for a complete and proper installation. Including but not limited to the following described items:
B. Concrete for composite floor construction.
C. Concrete floors and slabs on grade.
D. Concrete footings, shear walls, elevator shaft walls, foundation walls, and pit walls.
E. Architectural exposed concrete.
F. Joint devices associated with concrete work.
G. Miscellaneous concrete elements, including locker bases, equipment pads, light pole bases, flagpole bases, thrust blocks, and bollards.
H. Integral concrete color additives.
    1. North foundation wall at Multipurpose Room (C225).
    2. Concrete bench inside Corridor B1 B142.
I. Underslab vapor retarder.
J. Waterstops.
K. Concrete curing.
L. Do not include sales tax, refer to 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
B. Section 03 2000 - Concrete Reinforcing.
C. Section 03 3543 - Polished Concrete Finishing: Densifiers, hardeners, applied coatings, and polishing.
D. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
E. Section 32 1313 - Concrete Paving: Sidewalks, curbs, gutters and sealer.
F. Divisions 21, 22, 23: Mechanical items for casting into concrete.
G. Division 26: Electrical items for casting into concrete.

1.03 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
B. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete; 1998 (Reapproved 2004).
C. ACI 301 - Specifications for Concrete Construction; 2020.
D. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
F. ACI 305R - Guide to Hot Weather Concreting; 2020.
G. ACI 306R - Guide to Cold Weather Concreting; 2016.
H. ACI 308R - Guide to External Curing of Concrete; 2016.

I. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
N. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
O. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
P. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.
R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2019.
S. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
T. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
U. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2018.
V. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
W. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
X. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.
Y. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
Z. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.
AA. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete; 1992.
BB. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.
CC. NSF 61 - Drinking Water System Components - Health Effects; 2021.
DD. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.
    1. In areas receiving Special Concrete Floor Finishes, coordinate with Finish Manufacturer and Installer for special requirements. Applies to the Sections listed below if any.
        a. Section 03 3511 or 03 3515
        b. Section 03 3515
    2. Topics for discussion may include: Design mixture, placement schedule, placement methods, tolerances, curing method, jointing, and slab protection.
    3. Record, type, and distribute meeting minutes within 5 days of the meeting to all concerned parties, including but not limited to the Owner's Representative, Architect, and all attendees.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
   1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives and special concrete finishes.
C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
   2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
   3. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
   4. Indicate proposed mix design complies with admixture manufacturer's written recommendations.
D. Shop Drawings: Submit plans showing locations of construction and control joints for Engineer/Owner review.
E. Samples: Submit samples of underslab vapor retarder to be used.
F. Samples: Submit two,12 inch long samples of construction joint devices.
G. Test Reports: Submit report for each test or series of tests specified.
H. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
I. Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of Portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.
J. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.
   1. Maintain one copy of each document on site.
B. Follow recommendations of ACI 305R when concreting during hot weather.
C. Follow recommendations of ACI 306R when concreting during cold weather.
D. Vapor Barrier Installation: Conduct pre-installation conference and installation review prior to concrete placement, either in-person or digitally.

1.07 MOCK-UP

A. Mockups: Before casting architectural concrete, build mockups using the same procedures, equipment, materials, finishing procedures, and curing procedures that will be used for producing architectural concrete, to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, color, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Panel Size: Sufficient to illustrate full range of treatment, 6 by 6 feet (2 by 2 meters) minimum.
   2. Number of Panels: Two.
   3. Locate where directed by Architect.

B. For accurate color, the quantity of concrete mixed to produce the mock-up should not be less than 1 cubic yard and should always be in full yard increments. Construct sample panels using processes and techniques intended for use on permanent work, including curing procedures. Individual workers who will perform the work for the Project will produce the mock-up. Allow for sufficient time for full curing process.
C. Build mockups of typical wall of cast-in-place architectural concrete as indicated on Drawings, including vertical and horizontal rustication joints, and any sculptured features.
D. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints as applicable.
E. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair to match adjacent undamaged surfaces.
F. In presence of Architect, demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
G. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
H. Mock-up may remain as part of the Work.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Contractor shall guarantee his/her work for a period of One (1) year from date of Substantial Completion. Guarantee form will be found in Section 01 7800.

PART 2 PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 1000.

2.02 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 2000.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I Normal, Type II Moderate, or Type II Moderate Portland type.
    1. Acquire cement for entire project from same source.
B. Fine and Coarse Aggregates: ASTM C33/C33M.
    1. Acquire aggregates for entire project from same source.
C. Fly Ash: ASTM C618, Class F.
D. Powdered Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
    1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
    2. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).
        a. Basis of Design Manufacturer:
            1) Butterfield
                (a) Colors:
                    (1) Color 1 - U49 Deep Charcoal.
    3. Manufacturers:
        a. BRICKFORM; BRICKFORM Liquid Integral Color: www.brickform.com.
        b. Butterfield Color: www.butterfieldcolor.com.
        c. Davis Colors: www.daviscolors.com.

d. Solomon Colors; Solomon ColorFlo Liquid Colors: www.solomoncolors.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

A. Chemical Admixture:
1. Manufacturers:
a. Sika Corporation: www.sikaconstruction.com
b. GCP Applied Technologies; www.gcpat.com
c. Master Builders Solutions US LLC: www.master-builders-solutions.com
d. Euclid Chemical Company: www.euclidchemical.com
e. Substitutions: See Section 01 6000 - Product Requirements.

B. Do not use chemicals that will result in soluble chloride ions in excess of 0.05 percent by weight of cement.

C. All admixtures to come from same manufacturer. Verify that admixtures are compatible.

D. Air Entrainment Admixture: ASTM C260/C260M.
1. Ensure that certification attesting to compliance with ASTM C260/C260M is furnished.
2. Ensure that all exterior concrete flatwork, curbs and gutters, and catch basins have an air-entraining agent.
3. Manufacturers:
a. "Airalon 3000" manufactured by Grace Construction Products.
b. "MasterAir" Series manufactured by Master Builders Solutions US LLC.
c. Substitutions: See Section 01 6000 - Product Requirements.

E. Water Reducing (set controlling) Admixtures:
1. Adjust concrete to produce the required rate of hardening for varied climatic and job site conditions.
2. Ensure that admixture does not reduce the amount of cement required. Amounts as accepted by Architect/Engineer. Do not use calcium chloride or admixtures that contain calcium chloride.
3. Ensure that Field Service, a qualified concrete technician employed by the manufacturer, is available upon request to assist in proportioning concrete materials for optimum use, and to advise on proper use of the admixture and adjustment of concrete mix proportions to meet the jobsite and climatic conditions.
4. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
a. Approval in writing required from Architect.
5. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
a. Under 40 degrees F ambient temperature - Accelerate (Approval in writing required from Architect).
6. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
a. Over 80 degrees F ambient temperature - Retard.
7. Water Reducing Admixture: ASTM C494/C494M Type A.
a. Between 40 degrees F and 80 degrees F ambient temperature - Normal rate of hardening.
8. Shrinkage Reducing Admixture:
a. ASTM C494/C494M, Type S.
b. Products:
1) GCP Applied Technologies; Eclipse 4500: www.gcpat.com.
2) Substitutions: See Section 01 6000 - Product Requirements.
9. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.

a. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
b. Admixture Composition: Hydrophobic polymer waterproofing and corrosion inhibitor, functioning by closing concrete pores and chemical bonding.
c. Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 200 psi; provide test reports.
d. Potable Water Contact Approval: National Science Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with NSF 61 and NSF 372.
e. Products:
    1) ConShield Technologies, Inc; Crystal X: www.conshield.com.
    2) MasterLife 300 Series; Master Builders Solutions US LLC: www.master-builders-solutions.com.
    3) W. R. Meadows, Inc; ADI-CON CW Plus: www.wrmeadows.com.
    4) Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Underslab Vapor Barrier: 15 mil high performance multi-layered virgin polyolefin, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs.Maintain water vapor permeance less than 0.01 perms before and after mandatory conditioning testing per ASTM E1745 Section 7.1.
    Single-ply polyethylene is prohibited.
    1. To be installed under all Slabs on Grade.
    2. Installation: Comply with ASTM E1643.
    3. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor barrier.
    4. Products:
        a. Stego Industries, LLC: www.stegoindustries.com.
        b. Tex-Trude, LP; Xtreme Vapor Barrier (15-mil): www.tex-trude.com.
        c. Tex-Trude, LP; Xtreme Vapor Barrier (20-mil): www.tex-trude.com.
        d. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com.
        e. Fortifiber Building Systems Group; Moistop Ultra 15: www.fortifiber.com.
        f. Raven Industries; VaporBlock 15 mil: www.ravenind.com.
        g. Substitutions: Not permitted.
B. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
    1. During epoxy mixing and application process follow the epoxy manufacturer's instructions exactly.
C. Post-installed Adhesive Anchors: Use only at locations indicated on the Structural Drawings
    1. All bars anchored in epoxy or acrylic are to be observed by the Engineer or inspected by the Special Inspector prior to covering up.
    2. Manufacturers:
        a. Refer to Structural Notes.

2.06 BONDING AND JOINTING PRODUCTS

A. Epoxy Bonding System:
    1. Complying with ASTM C881/C881M and of Type required for specific application and moisture insensitive.
    2. Products:
        a. Euclid Chemical Company; DURAL FAST SET LV: www.euclidchemical.com.

b. Substitutions: See Section 01 6000 - Product Requirements.

B. Waterstops: PVC, complying with COE CRD-C 572.
   1. Size and Configuration: As required for specific application.
   2. Products:
      a. Greenstreak Inc, St Louis, MO www.greenstreak.com.
      b. W R Meadows of Canada, Milton, ON www.wrmeadows.com.
      c. Sika Waterstop Systems - Sika USA usa.sika.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
   1. Material: ASTM D1751, cellulose fiber.

D. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.

2.07 CURING MATERIALS

A. Evaporation Retarder: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
   1. Manufacturers:
      a. Dayton Superior Corporation: www.daytonsuperior.com.
      b. Euclid Chemical Company; EUCOBAR: www.euclidchemical.com.
      c. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com.
      d. W. R. Meadows, Inc; Evapre or Evapre-RTU: www.wrmeadows.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound, that dissipates within 3 to 5 weeks; complying with ASTM C309, Type I, Classes A and B.
   1. Manufacturers:
      a. Dayton Superior Corporation: www.daytonsuperior.com.
      b. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC: www.euclidchemical.com.
         1) Dayton Superior Corporation; Clear Resin Cure J11W.
         2) Dayton Superior Corporation; Clear Cure VOC J7WB.
      c. Kaufman Products Inc; Thinfilm 420 Resin Base: www.kaufmanproducts.net.
      d. SpecChem, LLC; SpecRez: www.specchemllc.com.
      e. W.R. Meadows, Inc: www.wrmeadows.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. Removable Curing Compound: VOC-compliant curing compound designed to be easily removed by the application of a cleaner/remover for all slabs that will receive stains, dyes, sealers, densifiers, coatings, or adhesives. For interior use only.
   1. Products:
      a. Euclid Chemical Company: www.euclidchemical.com.
         1) Removable Curing Compound: Kurez RC-100.
         2) Cleaner/Remover: Kurez RC-off.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Curing Compound, Non-dissipating: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C309.
   1. Vehicle: Water-based.
   2. Gloss: Low.
   3. Solids by Mass: 15 percent, minimum.
   4. VOC Content: OTC compliant.

5. Products:
    a. Kaufman Products Inc; Krystal 15 Emulsion: www.kaufmanproducts.net.
    b. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Dress & Seal WB: www.lmcc.com.
    c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Dress & Seal WB 30: www.lmcc.com.
    d. The QUIKRETE Companies; QUIKRETE® Acrylic Concrete Cure & Seal: www.quikrete.com.
    e. W. R. Meadows, Inc; VOCOMP-20: www.wrmeadows.com.
    f. Substitutions: See Section 01 6000 - Product Requirements.

E. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
1. To be used on all exterior concrete.
2. Vehicle: Solvent-based.
3. Solids by Mass: 30 percent, minimum.
4. VOC Content: OTC compliant.

F. Moisture-Retaining Sheet: ASTM C171.
1. White burlap-polyethylene sheet, weighing not less than 10 ounces per linear yard, 40 inches wide..

G. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

A. General Concrete Mix Requirements:
1. Obtain design of concrete mixes, including recommended amounts of admixture and water to be used in the mixes, from a qualified independent testing laboratory or agency, or from a mill or ready-mix plant properly equipped to design concrete mixes. A professional engineer currently registered as a civil or structural engineer in the State of Utah will perform and certify the design. Contractor shall ensure that the laboratory, agency, mill, or ready-mix plant used meets applicable requirements of ASTM E329. Contractor shall pay costs of obtaining the mix designs.
2. Ensure that selection of mix proportions conforms to the applicable requirements of ACI 211.1 and ACI 211.2. Ensure that concrete complies with ACI 301 and ACI 318, as applicable. Ensure that mix designs will produce concrete suited for proper placement and finishing.
3. Indicate brands, types and quantities of admixtures included in mix designs. If fly ash is proposed, identify it as such (e.g., “fly ash”), and identify the percentage of cement replacement in the mix design.
4. If concrete is to be placed by pumping, ensure concrete mixes are designed in accordance with the applicable requirements of ACI 304R and ACI 304.2R, and that strengths and slumps are included.
5. Ensure that mix designs indicate the location of each mix within the structure.
6. Ensure that fly ash does not exceed 20 percent in mix designs with replacement of Portland cement by weight with fly ash.
7. Ensure that mix design for architectural concrete and formed concrete that will be exposed to the public includes 10 percent minimum replacement of the cement with fly ash along with a plasticizing admixture, conforming with ASTM C1017, to provide a dense and plastic concrete mix that completely fills out the forms and form detail without air holes and rock pockets.

8. Ensure that mix design for integrally colored concrete indicates brand type of natural or synthetic metallic oxide or pigment, and quantity used, all prepared as specified in ASTM C979/C979M. Compensate for fly ash with additional pigment as applicable. Ensure that concrete encasements of below-grade electrical conduits and ductbanks containing circuits over 600 Volts are integrally colored .
9. Ensure that mix design for mass concrete has a percentage of fly ash replacement of cement by weight to reduce the amount of heat generated during heat of hydration.
10. Ensure that mix designs of exterior concrete include air entrainment by total volume of concrete: 4 to 6 percent for 1 1/2 inch maximum size coarse aggregate; 5 to 7 percent for 3/4 or 1 inch maximum size coarse aggregate in accordance with ASTM C173/C173M.
11. Ensure that aggregates conform to Standard Specifications for Concrete Aggregates ASTM C33.
12. Ensure that calcium chloride or other materials containing chlorides are corrosive to reinforcing steel are not used as an admixture in post-tensioned concrete.
13. Concrete Strength: Establish required average strength for concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
14. Drying Shrinkage of Concrete: Establish required “Drying Shrinkage” for concrete on the basis of field experience or trial mixtures, as specified in ASTM C157and ASTM C490.

B. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
   1. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

C. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.
   1. Mix Design: Refer to structural notes.
   2. Replace as much Portland cement as possible with fly ash, ground granulated blast furnace slag, silica fume, or rice hull ash as is consistent with ACI recommendations.

D. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

E. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

F. Type - A - Concrete - all building and exterior concrete.

G. Structural Lightweight Concrete:
   1. Mix Design: Refer to structural notes.

H. It is Contractors responsibility to recommend adjustments to mix design to meet specification requirements, based on job site conditions. Refer to Paragraph FLOOR FLATNESS AND LEVELNESS TOLERANCES of this Section for floor flatness tolerances.
   1. Maximum Aggregate Size: 3/4 inch.

2.09 MIXING

A. Ensure that concrete is ready-mixed batched, mixed, and transported in accordance with ASTM C94/C94M, "Specifications For Ready-Mixed Concrete," unless a higher standard is called for.
   1. Ensure that plant equipment and facilities conform to the "Checklist For Certification of Ready Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association.

B. For each load of concrete delivered, ensure that a delivery ticket is submitted that shows the following information:
   1. Number of cubic yards.
   2. The exact amount of cement and fly ash (if allowed); this can be indicated either by weight or quantity.

3. The amount of mixing water including free moisture in aggregates; this can be indicated either by weight or quantity.
4. Amount of slump in inches.
5. Type of cement.
6. Amount of air entrainment when delivered at job site.
7. Do aggregates meet ASTM specified - yes or no. Indicate maximum size aggregate.
8. Amount and brand (or ASTM) of admixture other than air entraining agent (if any) previously accepted in writing by Architect.

C. Contractor shall ensure that delivery tickets are given to the Job Superintendent or Foreman; Job Superintendent and Foreman shall see that tickets are delivered to the Architect and Testing Contractor once a week. Note exact location of concrete on job.

D. Color-conditioned admixture:
1. Batching and Depositing Materials (Follow manufacturer's written instructions): Ensure that the quantity of concrete being mixed in a mixer is not less than one-third of the capacity of mixing drum (a minimum of 3 yards in a 9 yard truck) and that it is always in full yard increments.
   a. Concrete mix control must be such as to provide good batch-to-batch uniformity. Use manufacturer's method of wet-checking the color of each load prior to being placed. Contact manufacturer for details of procedure.
   b. Ensure that the slump of concrete is consistent throughout the project and that no water is be added after a portion of the batch has been discharged. If concrete has started to set, do not retemper; discard.
   c. Deposit Colored Concrete near its final position to avoid segregation due to rehandling or flowing.
   d. When colored concrete is to be pumped, ensure that the priming slurry for the hose is colored with admixture.

E. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Verify that forms are clean and free of rust before applying release agent.

B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

C. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's written instructions.
1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

D. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink epoxy grout.

E. Interior Slabs on Grade:
1. More than 4 inches minimum of compactible granular fill, unless noted otherwise.
2. Level and compact base material.
3. Install vapor barrier under all interior slabs on grade in accordance with ASTM E1643.

4. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
5. Extend vapor barrier to the perimeter of the slab. If practical, terminate at the top of slab, otherwise (a) at point acceptable to the structural engineer or (b) where obstructed by impediments, such as rebar, dowels, waterstops, or any other site condition requiring early termination of the vapor barrier.
6. At point of termination, seal vapor barrier to foundation wall, grade beam, or slab itself. If sealing to foundation wall use double-sided perimeter sealing tape as recommended by manufacturer. When sealing to placed slab, use textured tape engineered to bond to newly placed concrete slabs per manufacturer's instructions.
7. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.
8. Repair damaged vapor barrier before covering. Avoid use of non-permanent stakes driven through vapor barrier.

F. Subgrade Preparation: Provide final check of finish grading before reinforcing is placed, and make any required adjustments. Provide ground surfaces at optimum moisture content (as determined by Soils Engineer).

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.
B. Place concrete for floor slabs in accordance with ACI 302.1R.
C. At locations shown on architectural and/or mechanical drawings, provide 6 inch (150 mm) high concrete housekeeping pads where indicated for equipment.
D. Where floors are indicated to be recessed for topping slab, or for floor tile that slope to drains, ensure that the concrete subfloor is sloped to provide for consistent thickness of setting bed, no exceptions.
   1. Any recessed floor which does meet the required slope will be replaced at no cost to the owner.
E. Recessed slab at Wood Floor Locations: Coordinate recessed depth with wood floor specifications and approved shop drawings.
F. Be aware that an Underslab Vapor Retarder will be installed and protect vapor retarder during all concrete floor forming and installation. Do not allow screed stakes or other penetrations. Take all required precautions to prevent excess moisture from entering the base under the vapor retarder prior to, during, and after installing the concrete slab on grade.
   1. Repair underslab vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches (150 mm) and seal watertight.
G. The Soils Engineer shall determine the moisture content of the base material prior to placing the concrete and shall make the final determination as to whether the moisture content of the base material is appropriate for concrete placement.
H. Notify Architect not less than 24 hours prior to commencement of placement operations.
I. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
J. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
K. Place concrete continuously between pre-determined expansion, control, and construction joints.
L. Place floor slabs in checkerboard or saw cut pattern indicated.
M. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

A. Locate joints as indicated on the drawings.
B. Install joint devices in accordance with manufacturer's written instructions.
C. Anchor joint fillers and devices to prevent movement during concrete placement.
D. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
    1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
F. Install joint device anchors for expansion joint assemblies specified in Section 07 9513. Maintain correct position to allow joint cover to be flush with floor and wall finish.
G. Apply sealants in joint devices in accordance with Section 07 9200.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. An independent testing agency, as specified in Section 01 4300, will inspect finished slabs for compliance with specified tolerances.
B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
    1. Exposed to View and Foot Traffic: F(F) of 20; F(L) of 15.
    2. Under Raised Access Flooring: F(F) of 20; F(L) of 15.
    3. Under Thick-Bed Tile: F(F) of 20; F(L) of 15.
    4. Under Carpeting: F(F) of 25; F(L) of 20.
    5. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25.
C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
E. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot (3.05 m) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:
    1. 1/8 inch (3.2 mm).
F. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.
B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
    1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
    2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
    3. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.

4. Finish - Exposed Vertical Surfaces to be painted:
    a. Ensure that form ties are broken back 1 inch from the surface of the concrete.
    b. Remove form ridges and other projections immediately after forms are removed.
    c. Fill all voids and honeycomb larger than 5 mm in diameter with a 1-to-2 cement-fine sand mortar mix.
    d. Rub all patches with a carborundum brick.
    e. Intent is for patches to blend into surface and not stand out after painting.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
3. Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; exposed surfaces include all other exposed slab surfaces.
    a. **Coordinate with Finish Manufacturer and Installer for special requirements, Refer to Section 03 3511.**

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:50 nominal.
F. Concrete Polishing: See Section 03 3543.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
1. At ceramic/paver tile locations, DO NOT USE liquid curing compounds except removable curing compounds so as to promote enhanced tile installation.
2. In areas receiving Special Concrete Floor Finishes coordinate with Finish Manufacturer and Installer for special requirements, refer to Section 03 3511.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
1. Normal concrete: Not less than seven days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
D. Surfaces Not in Contact with Forms:
1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
3. Final Curing: Begin after initial curing but before surface is dry.
    a. Curing Compound: Apply in two coats at right angles.
        1) Apply curing compound at the application rate at which it meets ASTM C309.
        2) If sprayed on, backroll with short nap roller.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4300 - Quality Assurance.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.
C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, visual appearance or specified requirements as determined by the Architect.
C. Repair or replacement of defective concrete will be determined by the Architect. Contractor shall bear the cost of additional testing when defective concrete is identified.
D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.
B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

3.11 SCHEDULE - REFER TO DRAWINGS

END OF SECTION 03 3000

SECTION 03 4713

TILT-UP CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Tilt-Up Concrete work as required by the Drawings and/or specified herein including, but not limited to, the following described items.
B. Tilt-up, site cast concrete wall panels, integrally insulated, load-bearing, erected from forms to final position.
C. Supports, devices, load bearing supports, and attachments.
D. Grouting under panels.
E. Do not include sales tax, refer to Section 00 0104 - Notice to Contractors.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories: Formwork requirements.
B. Section 03 2000 - Concrete Reinforcing: Reinforcing steel and welding requirements.
C. Section 03 3000 - Cast-in-Place Concrete: Requirements for concrete for tilt-up panels.
D. Section 03 3000 - Cast-in-Place Concrete: Requirements for casting slab.
E. Section 05 1200 - Structural Steel Framing.
F. Section 05 5000 - Metal Fabrications: Miscellaneous metal for embedment.
G. Section 07 1900 - Exterior Water Repellents and Graffiti-Resistant Sealers.
H. Section 07 2100 - Thermal Insulation: Requirements for integral insulation.
I. Section 07 6200 - Sheet Metal Flashing and Trim: Requirements for reglets recessed in units.
J. Section 07 9200 - Joint Sealants: Sealing perimeter and intermediate joints.
K. Section 09 9123 - Interior Painting: Field-applied painting of tilt-up panels.
L. Section 09 9724 - Sealers - Interior Concrete, Precast and Masonry Sealers.

1.03 REFERENCE STANDARDS

A. ACI 301 - Specifications for Concrete Construction; 2020.
B. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
C. ACI 305R - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2010).
D. ACI 306R - Guide to Cold Weather Concreting; 2016.
E. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).
F. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
G. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

L. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
M. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.
N. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2018.
O. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2021a.
P. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
Q. ASTM C78/C78M - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading); 2022.
R. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
S. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
T. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
U. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
V. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
W. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
X. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022.
Y. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
Z. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene no later than two weeks prior to commencing work of this section.
    1. Contractor shall cast, paint, and erect mock-up panels specified in this Section for observation at this meeting.
    2. The following parties shall be present:
        a. Owner.
        b. Architect.
        c. General Contractor.
        d. Tilt-Up Subcontractor.
        e. Batch Plant Concrete Supplier.
        f. Painting Subcontractor.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' current data on manufactured items used, including recommended methods of installation, relevant installation limitations, and safety precautions.
C. Shop Drawings: Indicate layout, tilt-up unit locations, configuration, unit identification marks, reinforcement, integral insulation, insulated panel system connectors, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent components.
D. Integrally Insulated Panel System Manufacturer's Qualification Statement.
E. Integrally Insulated Panel System Manufacturer's Installation Instructions: Submit manufacturer's current installation instructions for system specified. Certify that copies are available at project site prior to start of tilt-up work.

F. Samples: Submit one panel, 24 inches by 24 inches in size illustrating surface finish, color and texture.
G. Proposed Mix Design: Submit proposed mix design for each tilt-up unit type before starting work, complying with Section 01 4300 - Quality Assurance.
H. Samples for Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
I. Laboratory Reports: Submit certified laboratory test reports confirming physical characteristics of materials used in performance of the Work of this section.
J. Integrally Insulated Panel System Design Data:
    1. Thermal Resistance: Submit calculations complying with ASHRAE Std 90.1 I-P, isothermal planes method, and demonstrating thermal resistance of integrally insulated panel system.
    2. Dew Point: Submit calculations complying with ASHRAE (FUND). Demonstrate condensation prevention, prevention of frost or ice formation on panels surfaces, and inner wall condensation potential of _____ ounce per day per square foot or less.
    3. Thermal Bowing and Crack Mitigation: Submit drawing details and written procedures for mitigation and repair of bowing and cracking in insulated concrete panels without full-thickness concrete sections or metallic connectors between wythes.
K. Integrally Insulated Panel System Manufacturer Qualification Statement.
L. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with ACI 318.
B. Maintain one copy of quality assurance standards on project site.
C. Designer Qualifications: Design units under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
D. Fabricator Qualifications: Company specializing in site-cast tilt-up concrete construction with minimum 5 years of documented experience in forming, casting, and erection of panels similar to size and amount as required for this project.
    1. Membership: Member in good standing of the Tilt-Up Concrete Association.
E. Integrally Insulated Panel System Manufacturer Qualifications: Company specializing in manufacturing integrally insulated tilt-up panel system specified in this section, with minimum 3 years of documented experience and approved by system manufacturer.
F. Sandblaster Qualifications: Company with minimum 5 years of documented experience in all types of sand blasting, creating different types of finishes, similar to type and amount as required for the project.
G. Welding Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.07 MOCK-UP

A. Provide a minimum of two mock-up panels as quality control for architectural finishes, coordination of work with other sections, testing, and observation of operation.
    1. Panel Sizes: Minimum 4 feet by 8 feet, using forming system and construction methods to be used on project.
    2. Details: Incorporate typical edge, reveal, and finish transition conditions as detailed.
    3. Finishes: Demonstrate full range of texture and inserts to be expected in completed panels.
    4. Architectural Liners: Incorporate vertical and horizontal liner joints in mock-up.

5. Construction Joints: Cast mock-up over slab joint or column joint if actual panels will be affected by such condition.

B. Locate where directed and maintain approved mock-up for comparison to finished work.
C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handling Tilt-up Units: Lift units to position, consistent with their shape and design. Lift and support only from support points.
B. Blocking and Lateral Support During Erection: Use materials that are clean and non-staining. Provide temporary lateral support to prevent bowing, warping, or cracking.
C. Protect units from staining, chipping, or spalling.

1.09 FIELD CONDITIONS

A. Adverse Weather: Do not construct formwork, place reinforcing steel or concrete, or erect panels during adverse weather unless measures acceptable to Architect are taken to prevent damage.
B. Cold Weather: Comply with provisions of ACI 306R for freezing or near-freezing conditions.
   1. Provide adequate equipment for heating and protecting concrete materials.
   2. Do not use concrete materials, reinforcing steel, forms, fillers, ground surface, or other materials that are frozen, frost-covered or that contain ice.
   3. If shelters are used, do not use fuel that will weaken concrete surfaces.
C. Hot Weather: Comply with provisions of ACI 305R for high temperature conditions.
   1. During periods of dry winds, low humidity, and other conditions that cause rapid drying, protect fresh concrete with an evaporation retardant or fine fog spray of water applied immediately after screeding and bull floating.
   2. Maintain protection until final finishing and curing compounds are applied.

1.10 GUARANTEE

A. This Contractor shall guarantee his work for a period of 1 year from the date of Substantial Completion. Include guarantee on form found in Section 01 7800.

PART 2 PRODUCTS

2.01 TILT-UP PANEL UNITS

A. Tilt-Up Panel Units:
   1. Concrete: Minimum 4500 psi miminum, 28-day strength; compliant with ACI 301.
      a. Unless indicated otherwise in the general structural notes.
   2. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
   3. Calculate structural properties of units in accordance with ACI 318.
   4. No fly ash permitted.
   5. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
   6. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.
   7. Provide lifting hardware and lifting system appropriate to panel size and configuration.

2.02 PANEL MATERIALS

A. Forms: Design to withstand stresses resulting from concrete casting process and to maintain panels within 1/4 inch deflection limit; construct from steel or wood, rigidly braced and with precise corners.

1. Include blockouts as required to provide openings detailed on drawings, designed to limit deflection during pouring to maximum of 1/8 inch.
2. Provide smooth and clean forming surfaces.
3. Panels may be stacked for ease of casting.
4. For forms attachment to slab, use non-intrusive glues or adhesives whenever possible in lieu of nails and bolts.

B. Concrete Materials:
1. Cement: ASTM C150/C150M, Type I - Normal Portland type; gray color.
2. Aggregates: ASTM C33/C33M.
   a. Acquire all aggregates for entire project from same source.
   b. Concrete shall contain the maximum amount of course aggregate consistent with strength and placability.
3. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.
4. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
   a. Color(s): As indicated.
   b. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).
      1) Allow for three pigmented colors.
   c. Basis of Design Manufacturer:
      1) Butterfield Color: www.butterfieldcolor.com.
         (a) Colors:
            (1) Color 1 - U49 Deep Charcoal.
            (2) Color 2 - U28 Charcoal.
            (3) Color 3 - U18 Gull Gray.
      2) Substitutions: See Section 01 6000 - Product Requirements.

C. Reinforcing Steel: Sizes and spacing as indicated.
1. Reinforcing Bars: As indicated in the general structural notes.
2. Reinforcing Bars: ASTM A615/A615M deformed steel bars, Grade 60.

D. Curing Compound: Liquid membrane-forming compound compliant with ASTM C309, Type I and ID, Class B.
1. Manufacturers:
   a. SpecChem, LLC; Spec Tilt WB: www.specchemllc.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

E. Curing Covers: Reusable, impregnated fiber mat with a white or light colored backing, compliant with ASTM C171 for reflectivity and moisture retention.

F. Non-Shrink Grout: ASTM C1107/C1107M; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
1. Minimum Compressive Strength at 48 Hours: 2,400 psi.
2. Minimum Compressive Strength at 28 Days: 10,000 psi.
3. Manufacturers:
   a. SpecChem, LLC; SC Multi-Purpose Grout: www.specchemllc.com.

G. Reveals: For reveals or relief in panel face, provide materials of adequate strength to withstand construction traffic and loads without damage.

2.03 FORM LINERS

A. Pattern: 2/236 California by RECKLI, www.reckli.com.

2.04 REVEAL AND ACCENT STRIPS

A. Material: Non-staining, non-reactive, high-density polyethylene.

2.05 SUPPORT AND LIFTING DEVICES

A. Lifting Hardware, Connecting, and Support Devices: ASTM A36/A36M steel; hot-dip galvanized in accordance with ASTM A153/A153M.
   1. For support of reinforcing steel, plastic-tipped steel or all plastic supports are also acceptable.
B. Miscellaneous Metal Items: Provide inserts, dowels, and other items to be cast into panels as specified in Section 05 5000galvanized after fabrication in accordance with ASTM A123/A123M.
C. All-Plastic Supports: Provide units of adequate strength, with surface contact of not more than 0.10 sq. inches per contact point, and colored to blend with concrete.
D. Bolts, Nuts, and Washers: ASTM A307 heavy hex bolts, Type A, hot-dip galvanized, with matching ASTM A563/A563M nuts and matching washers.
E. Primer: Zinc rich oil alkyd.

2.06 INTEGRALLY INSULATED PANEL SYSTEM

A. Integrally Insulated Panel System: Tilt-up concrete panel formed from two layers of concrete with continuous rigid insulation and non-conducting connectors between layers.
   1. Panel Type: Structurally non-composite.
   2. Connectors:
      a. Refer to structural drawings for deferred submittal requirements. Intended to be a delegated design.
   3. Continuous Insulation: Rigid polyisocyanurate (ISO) board insulation, ASTM C1289, Type II, Class 2 - Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of the core foam; factory fabricated with holes or slots for connectors of manufacturer-designated size and spacing.
   4. Provide insulation thickness of 2 inches.
   5. Manufacturers:
      a. Composite Technologies Corporation; Thermomass System NC: www.thermomass.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.07 ACCESSORIES

A. Non-Conduction Connectors for Integral Insulation: Corrosion- and alkali-resistant connectors designed and manufactured for use in insulated composite panels.
B. Integral Insulation: Rigid polyisocyanurate (ISO) board insulation.
C. Bearing Pads: High density plastic, 1/8 inch thick, smooth both sides.
D. Reglets: Specified in Section 07 6200.
E. Joint Sealants: Specified in Section 07 9200.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.
B. Verify that casting slab is cured and ready for work of this section. Fill cracks, saw cuts, joints, or defects that would adversely affect appearance of tilt-up panels.

3.02 PREPARATION

A. Coordinate site cast tilt-up operations with work of other sections to expedite the Work and avoid omissions and delays.

B. Apply bondbreaker to casting slab in accordance with manufacturer's recommendations.
C. Provide for erection procedures and induced loads during erection, and provide for temporary bracing that will remain in place until roof diaphragm has been completely installed and connected.

3.03 FORMING PANELS

A. General: Maintain environmental records and quality control program during production of tilt-up units. Make records available upon request.
B. Lay out panels in manner that will minimize joints in panel faces. Coordinate installation of inserts and anchorages.
C. Use form liners in accordance with manufacturer's instructions.
D. Maintain consistent quality during construction of forms.
E. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.
F. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items as indicated.
G. Place and embed flashing reglets in continuous lengths without gaps, and properly positioned. Refer to Section 07 6200.
H. Locate hoisting devices to permit removal after erection.
I. Work concrete thoroughly around reinforcement, around embedded items, and into corners of the forms. Consolidate concrete in accordance with ACI recommendations.
J. Cold joints are not permitted in any individual panel.
K. Integrally Insulated Panel System: Comply with manufacturer's written installation instructions.
    1. Install insulation over entire area of panel as soon as possible after leveling first layer of concrete. Insert connectors immediately.
    2. Do not allow concrete to reach initial set before installing connectors.
    3. Fully consolidate concrete around embedded connectors.
    4. Do not disturb concrete after initial set.
    5. Pour second layer of concrete after first layer has fully hardened.
    6. Protect concrete from rain, freezing temperatures, mechanical vibration, or other damage until panel is fully hardened.

3.04 PLACING AND CURING CONCRETE

A. Mix and deliver concrete in accordance with ASTM C94/C94M, Option A, and in compliance with recommendations of ACI 304R.
B. Protect freshly placed concrete from premature drying and excessively hot or cold temperatures.
C. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
D. Apply liquid membrane curing compound in accordance with manufacturer's recommendations.
E. Moist Curing:
    1. Cover panels completely with burlap strips immediately after finishing. Quickly and completely wet entire exposed surface.
    2. Cover panels with curing covers to prevent evaporation, and keep covered for seven days. Do not allow alternate wetting and drying.
F. Minor patching is acceptable, providing structural adequacy and appearance of units are not impaired.

3.05 FINISHING CONCRETE

A. Finish exposed surfaces of panels as indicated on drawings.
B. Grade A - Architectural Finish:

1. Panel surfaces must be free of voids, holes, pockets, and other surface deformations greater than 1/8 inch and must not telegraph imperfections from the casting surface, including floor joints.
2. Cracks in excess of 1/32 inch width are not acceptable.
3. Reveals may not deviate from their correct position by more than 1/8 inch in 10 feet.
4. Grind, fill and patch exposed surfaces of panels to produce smooth uniform for painting
5. Repairs must not be apparent from a minimum distance of 10 feet.

C. Grade B - Standard Finish:
1. Panel surfaces must be free of voids, holes, pockets, and other surface deformations greater than 1/4 inch.
2. Curing cracks are acceptable, but structural cracks resulting from erection forces are not acceptable.
3. Reveals may not deviate from their correct position by more than 1/4 inch in 10 feet.
4. Repairs must not be apparent from a minimum distance of 25 feet.

D. Grade C - Utility Finish:
1. Panel surfaces showing voids, holes, pockets, and other surface deformations are permissible, provided they do not affect the structural integrity of the panel and provided they do not exceed 1/2 inch in greatest dimension.
2. Cracked surfaces are permissible, provided the cracks have not resulted from structural weakness or failure and provided they do not present the potential for failure of the finish over the life of the building.

E. Interior Finish: Trowelled.
F. Painting: Prepare surfaces to be painted as specified in Section 09 9113.

3.06 SITE FABRICATION TOLERANCES

A. Unless otherwise approved by Architect, provide panels complying with casting tolerances as specified below.
B. Panel Height and Width:
1. Up to 20 feet: 1/4 inch maximum.
2. 20 to 30 feet: 3/8 inch maximum.
3. Each additional 10 foot increment: 1/8 inch maximum.

C. Panel Thickness: 3/16 inch maximum average variation through any vertical or horizontal cross section.
D. Skew of Panel or Opening: Measured as difference in length of the two diagonals:
1. Per 6 feet of diagonal dimension: 1/8 inch maximum.
2. Maximum total difference: 1/2 inch.

E. Panel Openings:
1. Size: 1/4 inch maximum.
2. Location of Centerline: 1/4 inch maximum.

F. Location and Placement of Embedded Items:
1. Inserts, Bolts, and Pipe Sleeves: 3/8 inch.
2. Lifting and Bracing Inserts: As specified by manufacturer.
3. Weld Plate Embedments: 1 inch for location; 1/4 inch for tipping and flushness.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency, as specified in Section 01 4300 - Quality Assurance, will perform concrete mix testing.
B. Take minimum of 4 cylinders and 4 beams for each 150 cubic yards or fraction thereof, of each class of concrete, for each day concrete is cast, or not less than once for each 5000 sq ft of panel area. Field cure test specimens.

1. Beams: Perform casting, curing, and testing in accordance with ASTM C78/C78M. Test two beams prior to panel erection, and average results to determine flexural strength. Retain remaining beams for additional testing, if required.
2. Cylinders: Make and cure test cylinders in accordance with ASTM C31/C31M. Test two cylinders at 7 days and two at 28 days.

C. Take one slump tests for every six test cylinders in accordance with ASTM C143/C143M.
D. Take one air entrainment test cylinder for each set of exterior concrete test cylinders taken.
E. Submit copies of test reports within 24 hours of test, indicating location of panels for each set of test results.

3.08 DEFECTIVE CONCRETE

A. Defective Concrete: If test results indicate concrete does not comply with specified requirements, Contractor with the agreement of Architect must adjust mix to provide acceptable concrete on subsequent work. For concrete not meeting specified requirements, Owner may require core specimens to be taken and tested, at Contractor's expense. Concrete cores that test below specified requirements will be deemed to be defective.
B. Repair or replacement of defective concrete will be determined by the Architect and will be paid for by Contractor. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
C. Do not patch, fill, touch-up, repair, or replace damaged or defective concrete except upon express direction of Architect for each individual area.

3.09 ERECTION

A. Before beginning erection operations, verify that site conditions are appropriate for the work. Mark elements to comply with designations indicated on approved shop drawings.
B. Employ erection equipment that will prevent damage to existing construction, permanent floor slabs, and tilt-up panels. Protect panels to prevent staining, warping, or cracking.
C. Set panels in assigned positions. Erect members level and plumb within allowable tolerances. Grout space under panels for full bearing, or provide additional support until subsequent grouting operations are completed.
D. Align and maintain uniform horizontal and vertical joints, as erection progresses.
E. When members require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect.
F. Weld units in place. Perform welding, including tack welds, in accordance with AWS D1.1/D1.1M.
G. Provide non-combustible shields during welding operations.
H. Touch-up field welds and scratched or damaged galvanized surfaces.
I. Brace panels not attached to building frame at time of erection, using a bracing system designed to resist wind and other applicable loads until all structural connections have been made. Provide minimum of two braces per panel and maintain connections daily.
J. Exposed Joint Dimension: 1/2 inch. Adjust units as required to bring joint dimensions within allowable tolerances.
K. Patch holes, cut-off anchors, surface defects, and damaged corners to match panel with epoxy/cement paste adhesive.
L. After panel erection, patch holes or other blemishes in casting slab that were caused by the panel casting or erection processes, using techniques acceptable to Architect.

3.10 ERECTION TOLERANCES

A. Unless otherwise approved by Architect, install site-cast tilt-up panels within erection tolerances as specified below.

B. Replace panels that cannot be installed within specified tolerances.
C. Joint Width Variation:
    1. Up to 20 feet tall panels: 1/4 inch maximum.
    2. Each additional 10 ft increment: 1/8 inch maximum.
    3. Do not increase or decrease joint width more than 50 percent from specified joint width in any case, as measured between panels at exterior face.
D. Joint Taper:
    1. Up to 20 feet tall panels: 1/4 inch maximum.
    2. Each additional 10 ft increment: 1/8 inch maximum.
    3. Maximum for entire length of panel: 3/8 inch width difference for non-parallel panel edges.
E. Panel Alignment:
    1. Horizontal and Vertical Joints: 1/4 inch maximum.
    2. Offset in Adjacent Exterior Panel Faces: 1/4 inch.

3.11 PROTECTION

A. Protect units from damage by subsequent construction activities.

END OF SECTION 03 4713

SECTION 04 2000

UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Reinforced Unit Masonry work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Concrete block.
C. Mortar and grout.
D. Integral water repellent admixture.
E. Reinforcement and anchorage.
    1. Installation only of reinforcing steel within all masonry.
F. Installation only of metal flashings.
G. Masonry lintels.
H. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
B. Section 03 4500 - Precast Architectural Concrete: Precast concrete lintels and decorative units.
C. Section 04 2113 - Brick Masonry.
D. Section 05 5000 - Metal Fabrications: Loose steel lintels.
E. Section 07 1900 - Exterior Water Repellents and Graffiti Resistant Sealers: Exterior and Interior masonry sealer.
F. Section 07 2500 - Weather Barriers: Water-resistive barriers or air barriers applied to the exterior face of the backing sheathing or masonry.
G. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
H. Section 07 8400 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
I. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.
J. Section 09 9123 - Interior Painting: Painting of masonry work.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
E. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2021.
F. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2021.
G. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.
H. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.

I. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
J. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2022a.
K. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
L. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.
M. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
N. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2021.
O. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
P. ASTM C331/C331M - Standard Specification for Lightweight Aggregates for Concrete Masonry Units; 2017.
Q. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
R. ASTM C476 - Standard Specification for Grout for Masonry; 2020.
S. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale); 2021.
T. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.
U. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
V. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2019.
W. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2014).
X. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2021.
Y. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
Z. ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2021.
AA. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
BB. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
CC. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
DD. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
EE. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
FF. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
GG. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
    1. See Section 01 3000 - Administrative Requirements, for meeting procedures.
    2. Coordinate with Section 07 2500 - Weather Barriers for compatibility with Flashing Materials.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.

D. Samples: Submit four samples of each type of masonry unit to illustrate color, texture, and extremes of color range.
E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
F. Design Data: Indicate required mortar strength, unit assembly strength in each plane, and supporting test data.
G. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
H. Manufacturer's and Installer's Qualifications.
I. Test Reports: Test reports for each type of building block used are to be submitted to the Architect/Engineer for review. Testing and reports are to be completed by an independent laboratory. Verify that test reports show:
    1. Compressive strength.
    2. 24-hour cold water absorption.
    3. Saturation coefficient.
    4. Initial rate of absorption (suction).

1.06 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
    1. Maintain one copy of each document on project site.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
D. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.4/D1.4M and no more than 12 months before start of scheduled welding work.
E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one source and by a single manufacturer for each different product required.
F. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

1.07 MOCK-UP

A. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, flashings (with lap joint, corner, and end dam), wall insulation, reinforcement, grout, and weather barrier in mock-up.
B. Locate where directed and face south.
C. Mock-up may remain as part of the Work, if undisturbed at time of substantial completion at the discretion of the Architect.

1.08 PRECONSTRUCTION TESTING

A. Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 4300 - Quality Assurance.
B. Clay Masonry: Test each type of clay masonry in accordance with ASTM C67/C67M.
C. Concrete Masonry: Test each type, class, and grade of concrete masonry unit in accordance with ASTM C140/C140M for compliance with requirements of this specification.
D. Mortar Mixes: Test mortars prebatched by weight in accordance with ASTM C780 recommendations for preconstruction testing.
E. Grout Mixes: Test grout batches in accordance with ASTM C1019 procedures.

F. Compressive Strength: Where indicated, test masonry prisms in accordance with ASTM C1314.
   1. Prepare two sets of prisms; test one set at 7 days and the other at 28 days.
   2. Clay masonry prisms: Height-to thickness ration of 5.0.
   3. Concrete masonry prisms: Height-to-thickness ratio of not less than 1.33 and not more than 5.0; apply correction factor per TMS 402/602 for ratio other than 2.0.

G. Flexural Bond Strength: Where indicated, test masonry prisms in accordance with ASTM E518/E518M, with tooled joints downward.

H. Water Permeance of Masonry: Test each type of concrete masonry units in accordance with ASTM E514/E514M for conformance to requirements of this specification.

1.09 REGULATORY REQUIREMENTS

A. Conform to the International Building Code ICC (IBC) for necessary requirements for fire-rated masonry construction.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
   1. Store block off ground to prevent contamination by mud, dust or material likely to cause staining or other defects.
   2. Cover materials when necessary to protect from elements.
   3. Protect reinforcement from elements.
   4. Mortar and Grout Materials:
      a. Keep sand dry and protect from freezing.
      b. Store cement and lime off the ground and protect from moisture. In extreme weather, it should be stored in an enclosed space such as a building or trailer.

1.11 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

1.12 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MASONRY CONTRACTORS

A. All masonry contractors must be prequalified by CM/GC.

2.02 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Sizes: Standard units with nominal face dimensions of:
      a. 16 inches by 8 inches (400 mm by 200 mm) and nominal depths of 8 inches.
      b. 8 inches by 8 inches (200 mm by 200 mm) and nominal depths of 8 inches.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and preformed single and double bullnose/chamfer as indicated on drawings or as required to complete the work.
   3. Load-Bearing Units: ASTM C90, normal or medium, with aggregate conforming to ASTM C331/C331M.
      a. Hollow block, refer to General Structural Notes on Drawings.

b. Minimum Unit Strength: 2,800 psi.
c. Admixtures: Integral water repellent admixture.
d. Exposed Faces: Standard Face and Honed Face where scheduled on drawings. Refer to elevations for detail and notation or as directed by Architect.
e. Colors: As selected by the Architect from manufacturer's full line.
1) Block may be standard grey color where painted or not exposed.

4. Accepted Manufacturers:
a. Amcor, Inc., Salt Lake City, UT: www.amcormasonry.com.
b. Richfield Block Co., Richfield, UT.
c. Sunroc, Orem, UT / St. George, UT: www.sunroc.net.
d. Substitutions: See section 01 6000 - Product Requirements.

2.03 MORTAR AND GROUT MATERIALS

A. Refer to General Structural Notes on Drawings.
B. Mortar: Type S.
C. Masonry Cement: ASTM C91/C91M, Type N.
1. Colored Mortar: Premixed cement as required to match Architect's color sample.
D. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
E. Hydrated Lime: ASTM C207, Type S.
F. Mortar Aggregate: ASTM C144.
G. Grout Aggregate: ASTM C404.
H. Water: Clean and potable.
I. Accelerating Admixture: Nonchloride type for use in cold weather.

2.04 ADMIXTURES

A. Water-Repellent Admixture System: Water repellent compound designed to reduce capillarity. <u>For all masonry units, mortar and grout.</u>
1. Performance Requirements: Masonry units, mortar, and grout shall meet the following requirements:
a. Water Permeance of Masonry: Use water-repellent admixtures capable of providing masonry assembly performance of no visible dampness on backs of three wall specimens after 72 hours of testing when evaluated using ASTM E514/E514M.
b. Flexural Bond Strength: ASTM C1072 minimum 10 percent increase compared to reference specimen.
c. Compressive Strength of Masonry Prisms: ASTM C1314, maximum 5 percent decrease.
d. Compressive Strength of Masonry Mortar: ASTM C109/C109M, minimum 80 percent measure compared to reference specimen.
e. Drying Shrinkage of Concrete Masonry Units: Maximum 5 percent increase in shrinkage.
f. Drying Shrinkage of Masonry Mortar and Grout: ASTM C1148 maximum 5 percent increase in shrinkage when compared to reference specimen.
2. Acceptable Products:
a. GCP Applied Technologies, Product - Dry-Block: www.gcpat.com/en-us.
b. BASF, Product - Rheopel: www.basf-admixtures.com.
c. Euclid Chemical Co., Product - Eucon Blocktite: www.euclidchemical.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 MORTAR MIXES

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Engineered Masonry; Type S.
   2. Mortar Strength: Refer to Structural Drawings.
   3. Acceptable Manufacturers:
      a. Spec Mix: www.specmix.com.
      b. Quick Crete Products Corporation: www.quickcrete.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.
B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
   1. Mortar Colorant: Shall be only pure mineral oxide and in no case, exceed 10 percent of the weight of the cement.
   2. Color shall be as selected by the Architect from manufacturer's full line.
   3. Materials shall be chemically inert, finely ground, lime-proof pigment.
C. Use only mortar containing integral water repellent mortar admixture at the manufacturer's recommended addition rate and mixed according to the manufacturer's recommendations.

2.06 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
   1. Add integral water repellent admixture during mixing in conformance with the admixture label instructions and the recommendations of the manufacturer.
B. Retempering of mortar after initial mix is not allowed.
C. Maintain sand uniformly damp immediately before the mixing process.
D. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
E. Do not use anti-freeze compounds to lower the freezing point of mortar.
F. Retempering of mortar after initial mix is not allowed.

2.07 GROUT MIXES

A. Mix Design: 2,800 psi (19 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.
   1. Use fine grout for spaces with smallest horizontal dimension of 2 inches or less.
   2. Use coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
B. Use only grout containing integral water-repellent mortar admixture at the manufacturer's recommended addition rate and mixed according to the manufacturer's recommendations.

2.08 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.
B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.
C. Add admixtures in accordance with manufacturer's instructions; mix uniformly.
   1. Add integral water repellent admixture during mixing in conformance with the admixture label instructions and the recommendations of the manufacturer.
D. Do not use anti-freeze compounds to lower the freezing point of grout.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
B. Clean reinforcement of loose rust.
C. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
    1. Bond: Running.
    2. Coursing: One unit and one mortar joint to equal 8 inches.
    3. Mortar Joints: Concave.
D. Brick Units:
    1. Bond: Running.
    2. Coursing: Three units and three mortar joints to equal 8 inches.
    3. Mortar Joints: Concave.

3.04 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar and mortar smears as work progresses.
D. Tool all joints with an appropriate sized tool when joints are thumb-print hard.
E. All joints which are concealed by other construction materials and finishes shall be "tooled" (no exceptions).
F. Interlock intersections and external corners, except for units laid in stack bond.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled, resilient base is scheduled, or bitumen dampproofing is applied.

3.05 REINFORCEMENT AND ANCHORAGE

A. Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.
    1. Welding of splices is not permitted.
B. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
    1. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units or saw to accommodate reinforcement.

3.06 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
2. Remove or cover protrusions or sharp edges that could puncture flashings.
3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

C. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.07 GROUTING

A. Perform all grouting by means of low-lift technique. Do not employ high-lift grouting.

B. Low-Lift Grouting:
1. Limit height of pours to 48 inches.
2. Limit height of masonry to 16 inches above each pour.
3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1 1/2 hours.

3.08 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Form expansion joint as detailed and as located on Drawings.

D. This Contractor shall coordinate locations of joints with structural columns, masonry layout, and suggested joint layout on the drawings, including those that extend to upper floor levels.
1. Maximum spacing shall be 30 feet (9.1 m) on center, unless approved by the Architect, and preferred spacing of 24 feet (7.3 m) to 28 feet (8.5 m) on center.

3.09 BUILT-IN WORK

A. Build into new masonry, all bolts, bearing plates, anchors, nailing blocks, inserts, lintels, etc. indicated on the contract drawings, as furnished by the structural and miscellaneous steel subcontractor specified in Sections 05 1200 and 05 5000.

B. As work progresses, install built-in metal door frames, glazed frames, fabricated metal frames, anchor bolts, plates, and lintels and other items to be built into the work and furnished under other sections.

C. Install built-in items plumb, level, and true to line.

D. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

E. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4300 - Quality Assurance.
B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67/C67M requirements, sampling 5 randomly chosen units for each 50,000 installed.
C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
D. Mortar Tests: Test each type of mortar in accordance with recommended procedures in ASTM C780, testing with same frequency as masonry samples.
E. Test and evaluate grout in accordance with ASTM C1019 procedures.
    1. Test with same frequency as specified for masonry units.
F. Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314 and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results.

3.13 CLEANING

A. Remove excess mortar and mortar smears as work progresses.
B. Replace defective mortar. Match adjacent work.
C. Follow block manufacturer's recommendations for cleaning.
D. Thoroughly wet surface of masonry on which no green efflorescence appears.
E. Immediately rinse with clear water.
F. Do small sections at a time.
G. Work from top to bottom.
H. Use non-metallic tools in cleaning operations.
I. Protect all sash, metal lintels and other corrodible parts when masonry is cleaned with acid solution.
J. Remove white or green efflorescence in accordance with block manufacturer's recommendations.
K. Adjust pressure of washers so as not to "pock", sandblast or otherwise damage faces of masonry units. All units damaged in such manner shall be removed and replaced by the masonry contractor at no expense to the Owner.

3.14 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
B. Protection of Masonry Method:
    1. Wall Covering:
        a. During erection, and after completion, cover top of all walls with strong waterproof membrane.
        b. Extend cover minimum of 24 inches (610 mm) down both sides.

c. Hold cover securely in place and maintain throughout construction until all walls are covered with roofing membrane and/or cap flashings.

C. Staining:
1. Prevent grout or mortar from staining the face of masonry to be left exposed or painted:
a. Immediately remove grout or mortar in contact with face of such masonry.
b. Protect all sills, ledges and projections from droppings of mortar, protect door jambs and corners from damage during construction.

D. Cold Weather Protection:
1. Preparation:
a. If ice or snow has formed on masonry bed, remove by carefully applying heat until top surface is dry to the touch.
b. Remove all frozen or damaged masonry.
2. When brick suction exceeds recommendations, sprinkle with heated water:
a. When units are above 32 degrees F, heat water above 70 degrees F.
b. When units are below 32 degrees F, heat water above 130 degrees F.
3. Use dry masonry units.
4. Do not use wet or frozen units.

E. Construction Requirements While Work is Progressing:
1. Air Temperature 40 degrees F to 32 degrees F:
a. Heat sand or mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
b. Cover walls and materials to prevent wetting and freezing. Covers should be plastic or canvas.
2. Air Temperature 32 degrees F to 25 degrees F:
a. Heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
b. Maintain temperatures of mortar on boards above freezing.
c. With wind velocities over 15 mph, provide windbreaks during the workday and cover walls and materials at the end of the day to prevent wetting and freezing.
d. Maintain masonry above freezing for 16 hours using auxiliary heat or insulated blankets.
e. Heat grout materials to 90 degrees F to produce in-place grout temperature of 70 degrees F at end of work day.
3. Air Temperature 25 degrees F to 2 degrees F:
a. Heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
b. Maintain mortar temperatures on boards above freezing.
c. Use salamanders or other heat sources on both sides of walls under construction.
d. Use windbreaks when wind is in excess of 15 mph.
e. Heat grout materials to 90 degrees F to produce in-place grout temperature of 70 degrees F at end of work day.
4. Air Temperature 20 degrees F and Below:
a. Heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
b. Provide enclosures and auxiliary heat to maintain air temperature above 32 degrees F.
c. Minimum temp. of units when laid: _____ degrees F.
d. Heat grout materials to 90 degrees F to produce in-place grout temperature of 70 degrees F at end of work day.

F. Protection Requirements for Completed Masonry and Masonry Not Being Worked On:
1. Minimum air temperature 40 degrees F to 32 degrees F:

a. Refer to paragraph 3.14-B.

2. Mimimum air temperature 32 degrees F to 25 degrees F:
   a. Refer to paragraph 3.14-B.
3. Minimum air temperature 25 degrees F to 20 degrees F:
   a. Completely cover masonry with insulating blankets or equal protection for 24 hours, 48 hours for grouted masonry.
   b. Refer to paragraph 3.14-B.
4. Minimum air temperature 20 degrees F and below:
   a. Maintain masonry temperature above 32 degrees F for 24 hours by:
      1) Electric heating blankets,
      2) Infrared lamps,
      3) Or other methods acceptable to the Architect/Engineer.
   b. Refer to paragraph 3.14-B.

END OF SECTION 04 2000

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SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Structural Steel Framing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Wide flange steel beams and bearing plates complete with all bolts, nut, washers, headed studs for roof and floor structures. See details on structural drawings.
   1. Galvanize at exterior conditions.
C. Steel tube columns with base and cap plates, rods, bolts, nuts and washers for roof, floor and canopy structures. See details on drawings.
   1. Galvanized at exterior conditions.
D. All miscellaneous steel channels, tubes, angles, plates, bent plates, rods, nuts, bolts, washers, and headed stud anchors required for roof, floor, stair, exterior canopy, catwalk system, fly loft system, and miscellaneous wall support and framing. See details on drawings.
   1. Galvanized at exterior conditions.
E. Anchor rods incorporated in structure as shown on drawings.
F. All required plates, channels, angles, rods, bolts, etc. cast into concrete tilt-up wall panels.
   1. Galvanized at below grade conditions.
G. Structural steel framing members.
H. Structural steel support members, suspension cables, sag rods, and struts.
I. Base plates, shear stud connectors and expansion joint plates.
J. Grouting under base plates.
K. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 2100 - Steel Joist Framing.
B. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
C. Section 05 4000 - Cold-Formed Metal Framing.
D. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.03 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; 2017.
B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
C. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
D. AISC 207 - Standard for Certification Programs; 2023.
E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
G. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
I. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

J. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel; 2013 (Reapproved 2018).
K. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
M. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
N. ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2018, with Editorial Revision (2019).
O. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2019.
P. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
Q. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
R. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.
S. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
T. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
U. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.
V. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.
W. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
X. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2018.
Y. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
Z. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
AA. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a.
BB. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
CC. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2021.
DD. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
EE. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
FF. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
GG. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
HH. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
II. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
JJ. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
KK. SSPC-SP 3 - Power Tool Cleaning; 2018.

LL. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
C. Verify conditions at site affecting work of this Section and obtain accurate field dimensions. Report discrepancies between drawings and field dimensions to the Architect prior to commencing work.
D. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
E. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
F. Materials Test Reports: Submit independent test results or engineered performance analysis of structural thermal-break pad performance in bearing or slip-critical connections where shear and moment loads are applied.
G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
H. Designer's Qualification Statement.
I. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172 or AISC 201
J. Responsibility: The Contractor shall, alone, be responsible for the correctness of all shop drawings and for all shop and field fabrication. The review or comments on any drawings shall not relieve the Contractor of any responsibility for the correctness of the details. The Architect's review covers general design of details only and if any corrections are made which would cause members not to fit or would not give sufficient strength, the Contractor shall call the Architect's attention to it at once in writing so that corrections can be made. If the Contractor fails to do this, the sole responsibility rests upon him.
K. Omission of any material from the Contractor's shop drawings that is shown on the working drawings or called for in the specification, shall not relieve the Contractor from furnishing such material, even though the Architect/Engineer reviewed the Contractor's shop drawings.

1.05 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) Steel Construction Manual.
B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 1213.
C. Maintain one copy of each document on site.
D. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.
E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
F. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172 or AISC 201
G. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.

H. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

I. Welder, Tacker and Welding Operator Qualifications: Welds shall be made only by welders, tackers, and welding operators who have been previously qualified by tests as prescribed in the Code for Welding in Building Construction, AWS D1.1/D1.1M, latest edition, of the American Welding Society to perform the type of work required. All welding shall be in accordance with AWS D1.1, latest edition, of the American Welding Society to perform the type of work required.

1.06 GUARANTEE

A. The Contractor shall guarantee his work for a period of one (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

2.02 MATERIALS

A. Steel Plates, other Shapes, and other Shapes: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Rolled Steel Structural Shapes: ASTM A992/A992M.
D. Steel Shapes, Plates, and Bars: ASTM A242/A242M high-strength, corrosion-resistant structural steel.
E. Steel Bars: ASTM A529/A529M high-strength, carbon-manganese structural steel, Grade 50.
F. Steel Plates and Bars: ASTM A572/A572M, Grade 50 (345) high-strength, columbium-vanadium steel.
G. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.
H. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded.
I. Steel Bars: ASTM A108Grade 1018.
J. Steel Plate: ASTM A514/A514M.
K. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade 30 cold-rolled.
L. Pipe: ASTM A53/A53M, Grade B, Finish black.
M. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
N. Sag Rods: ASTM A36/A36M.
O. All-thread rod: ASTM A36/A36M
P. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C.
Q. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.
    1. Galvanized or zinc coated where used with chemically treated wood plates, coordinate with Section 06 1000.
R. Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436 Type 1 washers.
S. Headed Anchor Rods: ASTM F1554 Grade 36, plain.
T. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.
U. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
V. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
    1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.

2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
3. Height Change, Plastic State; when tested according to ASTM C827/C827M:
   a. Maximum: Plus 4 percent.
   b. Minimum: Plus 1 percent.
4. Manufacturers
   a. W.R. Meadows: www.wrmeadows.com.
   b. L & M Construction chemicals, Inc.: www.lmcc.com.
   c. US Spec: www.uspec.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

W. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

X. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Water Absorption: 0.5 percent by volume, maximum.
B. Shop fabricate to greatest extent possible.
C. Space shear stud connections as indicated on Structural Drawings.
D. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
E. Fabricate connections for bolt, nut, and washer connectors.
F. Develop required camber for members.

2.04 SHOP PRIMING

A. Shop prime structural steel members, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections, if primer does not meet the specified AISC slip coefficient.
   4. Surfaces to be fireproofed.
B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC Specifications as follows:
   1. Galvanized Conditions:
      a. SSPC-SP 6 - Commercial Blast Cleaning.
   2. Interior Conditions:
      a. SSPC-SP 3 - Power Tool Cleaning.
C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
D. Stripe paint corners, crevices, bolts, welds, and sharp edges.
E. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.05 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 6.
B. Shop prime structural steel members (unless noted to be galvanized). Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
C. Galvanize structural steel members, where indicated on drawings, to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.

2.06 SOURCE QUALITY CONTROL

A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) Specification for Structural Joints Using High-Strength Bolts, testing at least 10 percent of bolts at each connection.
B. Welded Connections: Visually inspect all shop-welded connections and test at least 10 percent of welds using one of the following:
   1. Radiographic testing performed in accordance with ASTM E94/E94M.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC 303.
B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
C. Field weld components and shear studs indicated on shop drawings.
D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) Specification for Structural Joints Using High-Strength Bolts.
E. Do not field cut or alter structural members without approval of Architect and Structural Engineer.
F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.03 GROUTING AND DRY-PACKING

A. Provide grouting and dry-packing of base plates, leveling plates, and all other like work indicated or required, except where specified for work of other trades. Use non-shrink grout for base plates, leveling plates, and steel columns.
B. Proportions and Mixing:
   1. Non-Shrink Grout: Shall be mixed with water to dry-pack or grout consistency as required.
C. Placing and Finishing: Place by forcing and rodding to completely fill all voids, for complete uniform bearing under plates. Finish exposed surfaces neatly with smooth finish and cure with damp burlap at least three (3) days.
D. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4300 - Quality Assurance.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC "Specification for Structural Joints Using High-Strength Bolts," testing at least 10 percent of bolts at each connection.
C. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:
    1. Radiographic testing performed in accordance with ASTM E94/E94M.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
    4. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION 05 1200

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SECTION 05 2100

STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Steel Joist Framing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
C. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
D. Supplementary framing for floor and roof openings greater than 12 inches.
E. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors for casting into concrete.
B. Section 04 2900 - Engineered Unit Masonry: Placement of anchors for embedding into masonry.
C. Section 05 1200 - Structural Steel Framing: Grouting base plates and bearing plates.
D. Section 05 1200 - Structural Steel Framing: Superstructure framing.
E. Section 05 3100 - Steel Decking: Bearing plates and angles.
F. Section 05 3100 - Steel Decking: Support framing for openings less than 18 inches in decking.
G. Section 05 5000 - Metal Fabrications: Non-framing steel fabrications attached to joists.
H. Section 07 8100 - Applied Fire Protection: Fireproof protection of joist framing and metal deck systems.

1.03 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
E. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
F. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film; 2017.
G. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.
H. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry; 2018.
I. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.
J. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.
K. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2021.

L. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
N. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
O. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
P. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders; 2020.
Q. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 2008.
R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
S. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
T. SSPC-SP 3 - Power Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
D. Designer's Qualification Statement.
E. Manufacturer's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172 or AISC 201.
F. Fabricator's Qualification Statement.
G. Erector's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.
C. Design and Installation Requirements: Refer to Structural Drawings.
D. Manufacturer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience.
E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.
F. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172 or AISC 201.
G. Erector Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI Technical Digest No. 9 requirements.

1.07 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Include guarantee on form in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Joists:
   1. Canam Group Inc: https://www.canam-construction.com.
   2. Nucor-Vulcraft Group: www.vulcraft.com.
   3. CMC Joist: www.cmcjoist.com.
   4. Valley Joist, Inc.: www.valleyjoist.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Open Web Joists: SJI Type K Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: 5 inches.
   3. Minimum End Bearing on Concrete or Masonry Supports: 4 inches.
   4. Finish: Shop primed.

B. Open Web Joists: SJI 100 Type LH Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standards.
   3. Minimum End Bearing on Masonry or Concrete Supports: Comply with referenced SJI standards.
   4. Finish: Shop primed.

C. Anchor Bolts, Nuts and Washers: ASTM A307 hot-dip galvanized per ASTM A153/A153M Class C.

D. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.

E. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.

F. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

A. Frame special sized openings in joist web framing as detailed.

B. Space stud shear connectors on top of top chords as shown on Structural Drawings.

2.04 FINISH

A. Shop prime joists.
   1. Do not prime surfaces that will be fireproofed, field welded, or in contact with concrete.
   2. Galvanize steel ledge angles and anchors to secure joists.
   3. For joists in exposed areas, dip joists upside down.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC Specifications as follows:
   1. Interior Conditions:
      a. SSPC-SP 3 - Power Tool Cleaning.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

D. Stripe paint corners, crevices, bolts, welds, and sharp edges.
E. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.
F. Prepare surfaces to be finished in accordance with SSPC-SP 3.

2.05 SOURCE QUALITY CONTROL

A. Provide shop testing of steel components as follows:
   1. As required by SJI Standards.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 ERECTION

A. Erect joists with correct bearing on supports.
B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
E. Position and field weld joist chord extensions and wall attachments as detailed.
F. Install supplementary framing for floor and roof openings greater than 12 inches.
G. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
H. Do not field cut or alter structural members without approval of joist manufacturer.
I. After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed, except surfaces specified not to be primed.
J. After the erection is complete, all structural steel is to be reviewed by the Architect and/or Structural Engineer.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Alignment: 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4300 - Quality Assurance.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts, testing at least 10 percent of bolts at each connection.
C. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds usingone of the following:
   1. Radiographic testing performed in accordance with ASTM E94/E94M.
   2. Ultrasonic testing performed in accordance with ASTM E164.
   3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   4. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION 05 2100

SECTION 05 3100

STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Steel Decking work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Roof deck.
C. Composite floor deck.
D. Supplementary framing for openings up to and including 12 inches.
E. Stud shear connectors.
F. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Concrete Reinforcing.
B. Section 03 3000 - Cast-in-Place Concrete: Concrete topping over metal deck.
C. Section 04 2900 - Engineered Unit Masonry: Placement of anchors for bearing plates embedded in reinforced unit masonry.
D. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
E. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
F. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 18 inches and shear stud connectors.
G. Section 05 2100 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.
H. Section 05 3400 - Acoustical Metal Decking
I. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.
J. Division 22 - Plumbing: Reinforcement pans with drain hub assemblies.
K. Section 07 8100 - Applied Fire Protection: Spray applied fireproofing.
L. Division 26 - Electrical: Electrical, telephone, data floor outlets, sleeves, gaskets, raceway, and covers.

1.03 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
E. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
G. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

H. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
I. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
L. SSPC-SP 3 - Power Tool Cleaning; 2018.
M. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
N. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
D. Certificates: Certify that products furnished meet or exceed specified requirements.
E. Submit manufacturer's installation instructions.
F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
G. Designer's Qualification Statement.
H. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172 or AISC 201

1.05 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.
C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172 or AISC 201
D. Installer Qualifications: Company specializing in performing the work of this Section with minimum Five years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.
B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

1.07 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Steel Deck:
    1. Canam Steel Corporation: https://www.canam-construction.com.
    2. Nucor-Vulcraft Group: www.vulcraft.com.

3. New Millennium: www.newmill.com
4. ASC Steel Deck: www. ascsd.com.
5. Valley Joist, Inc.: www.valleyjoist.com.
6. Verco Manufacturing Co.: www.vercodeck.com.
7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
   1. Calculate to structural working stress design and structural properties specified.
   2. Maximum Vertical Deflection of Floor Deck:1/360 of span.
   3. Maximum Vertical Deflection of Roof Deck: 1/240 of span.

B. Roof Deck: Non-composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
   2. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 33, Type 1.
   3. Primer: Shop primer over prepared and phosphatized substrate.
   4. Structural Properties:
      a. As indicated on Structural Drawings.
   5. Fire Resistance Classification: Comply with UL (FRD) Assembly Number: as indicated on drawings.

C. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
   1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
      a. Galvanized Floor Deck at Mechanical Room Areas.
   2. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 33, Type 1.
   3. Primer: Shop primer over prepared and phosphatized substrate.
   4. Structural Properties:
      a. As indicated on Structural Drawings.
   5. Fire Resistance Classification: Comply with UL (FRD) Assembly Number.

2.03 ACCESSORY MATERIALS

A. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
B. Welding Materials: AWS D1.1/D1.1M.
C. Fasteners: Galvanized hardened steel, self tapping.
D. Steel Sheet Metal: 18-gauge, shop primed with screw fastener connections.
E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
H. Flute Closures: Closed cell foam rubber, 1 inch thick; profiled to fit tight to the deck.

2.04 FINISH

A. Shop prime steel deck.
   1. Do not prime surfaces that will be fireproofed, field welded, or in contact with concrete.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC Specifications as follows:
   1. Galvanized Conditions:
      a. SSPC-SP 6 - Commercial Blast Cleaning.
   2. Ungalvanized Conditions:

a. SSPC-SP 3 - Power Tool Cleaning.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness no less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

D. Stripe paint corners, crevices, bolts, welds, and sharp edges.

E. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.

B. On concrete and masonry surfaces provide minimum 4 inch bearing.

C. On steel supports provide minimum 1 1/2 inch bearing.

D. Fasten deck to steel support members as indicated on Structural Drawings.

E. Side Seam Attachments: As indicated on Structural Drawings.

F. Weld deck in accordance with AWS D1.3/D1.3M.

G. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.

H. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

I. Weld stud shear connectors through steel deck to structural members below.

J. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

K. After the erection is complete, all structural steel is to be reviewed by the Architect and/or Structural Engineer.

END OF SECTION 05 3100

SECTION 05 3400

ACOUSTICAL METAL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Acoustical Metal Decking work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Acoustical roof deck located in the following areas:
C. Accessory hanging devices.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 2000 - Reinforcing: Concrete and Masonry Reinforcing.
B. Section 04 2731 - Reinforced Unit Masonry: Placement of anchors for bearing plates or angles embedded in masonry.
C. Section 05 1200 - Structural Steel Framing: Support framing for openings and shear stud connectors.
D. Section 05 2100 - Steel Joist Framing: Support framing for openings and shear stud connectors.
E. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.
F. Section 09 9123 - Preparation for and application of field painting.
G. Division 22 - Plumbing: Reinforcement pans with drain hub assemblies and attachments to acoustical roof deck.
H. Division 23 - HVAC: Attachments to acoustical roof deck.
I. Division 26 - Electrical: Electrical, telephone, floor outlets, sleeves, gaskets, raceway and covers, and other attachments to acoustical roof deck.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2012.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2020.
D. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2022.
E. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.
F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
G. ICC-ES - International Code Council Evaluation Service; Current.
H. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate length of fasteners for roofing and thermal insulation to avoid penetrating the finished bottom surface of the panels.
2. Coordinate locations and size of shop-cut access openings in bottom of panels with affected trades.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
B. Shop Drawings: Indicate panel placement, profiles, material thicknesses, finishes, layout, anchorage, and openings as shown on Structural Drawings. Show access openings and covers if required.
C. Product Data: Provide manufacturer's specifications, section properties, load tables, diaphragm sheer tables, dimensions, finishes, and noise reduction coefficients.
D. Samples: Provide full width sample of each type of deck to verify compliance with the specifications and the level of quality. Provide a sample of hanging devices.
E. Certificates: Certify that products furnished meet or exceed specified requirements.
F. Submit manufacturer's installation instructions.
G. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.06 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Utah.
B. Acoustical roof deck to be approved by the International Code Council Evaluation Service ICC-ES for use as a structural roof deck and shear diaphragm, and have a valid ICC-ES evaluation report.
C. Section properties to be computed in accordance with the American Iron and Steel Institute (AISI) Specification for Design of Cold-Formed Steel Structural Members. AISI S100-12
D. Welding to comply with applicable provisions of the American Welding Society AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
E. Superimposed Load and Diaphragm Shear Capacities to be computed in accordance with the requirements to the Steel Deck Institute SDI (DM).
F. Noise Reduction Coefficients to be verified by the results of sound absorption tests conducted in accordance with ASTM C423 and ASTM E795.
G. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with minimum 5 years of documented experience.
H. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store deck elevated on dry wood sleepers; slope for positive drainage and protect from weather with a ventilated covering.

1.08 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. EPIC Metals Corporation; Product - Toris-A: www.epicmetals.com.
B. Other Approved Manufacturers:
   1. Nucor-Vulcraft Group: www.vulcraft.com.
   2. Verco Manufacturing Co.: www.vercodeck.com.
   3. New Millennium: www.newmill.com
   4. Substitutions: See Section 01 6000 - Product Requirements.
      a. Manufacturer shall have been producing this product for a minimum of 5 years. Any product to be supplied must be approved by the architect a minimum of two weeks prior to bid date with a full width sample being submitted.

2.02 MATERIALS

A. Panels: Cold-formed from steel coils conforming to ASTM A653/A653M, Structural Quality, Grade 40 with minimum yield strength of 40,000 psi (40 ksi).
   1. Before forming, the steel coils to receive hot-dip protective coating of zinc conforming to ASTM A924/A924M Class G60 or G90 at Pool Area, as defined in ASTM A 653.
   2. Ensure that the actual gauge of the material for each area is as shown on the Structural Drawings.
   3. Ensure that minimum uncoated thickness of materials furnished is within 5 percent of the design thickness.

2.03 FABRICATION

A. Ensure that acoustical roof deck has continuous dovetail shaped ribs with quarter round edges as reveals.
B. Ensure that acoustical roof deck has full depth positive registering sidelaps that can be fastened by welds or screws.
C. Ensure acoustical roof deck is fabricated with perforations. Ensure that perforated areas are located in the bottom flat areas between the dovetail shaped ribs. Provide a minimum NRC value of .95. Establish this value by sound absorption tests without the use of fiberglass insulation above the panels

2.04 FINISH

A. Acoustical Roof Deck:
   1. Prime paint the top and bottom surfaces of the acoustical roof deck with manufacturer's standard white. Before painting, chemically clean and coat the galvanized steel with an acid wash pretreatment primer, then follow with a coat of the manufacturer’s standard prime paint and oven bake. Compatibility of field applied finish paint with factory applied prime paint shall be the responsibility of the painting contractor.

2.05 ACCESSORIES

A. Provide manufacturer's standard ridge plates, valley plates, transition plates, and closures as indicated on the structural drawings.
B. Provide openings and reinforcement for openings as required.
C. Ensure Wedge Nut hanging devices are installable and relocatable along the length of the interior ribs of the acoustical roof deck. Consult the manufacturer’s product data for minimum spacing, load capacities, and proper installation procedure of the Wedge Nut hanging devices.
D. Acoustical Roof Deck:

1. Ensure acoustic elements are provided for installation above the perforations in the bottom flat area between the dovetail shaped ribs. To facilitate field painting of the perforated surfaces, ensure that the sound absorbing elements are supported above the surface by spacers. The roofing contractor shall furnish the sound absorbing elements and spacers for installation under this specification section. specified in this section.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the supporting frame and other work relating to the acoustical roof deck to ensure the work has been properly completed.
B. Ensure that bundles of material are located on the supporting frame in such a manner that overloading of any individual framing members does not occur.
C. Ensure that all components of the acoustical roof deck are protected from significant damage during shipment and handling. If storage at the jobsite is required, elevate bundles or packages of materials above the ground, slope for positive drainage, and protect from the elements with a ventilated, waterproof covering.

3.02 INSTALLATION

A. Erect metal deck in strict accordance with SDI (DM), manufacturer's instructions and approved erection drawings. Align and level.
B. Before permanently fastening acoustical roof deck, place deck on the supporting frame and adjust to final position with ends accurately aligned and adequately bearing on the supporting frame. Maintain consistent coverage so that panels located in adjacent bays will be properly aligned.
C. Ensure that the cutting of acoustical roof deck to suit jobsite conditions is performed in a neat and workmanlike manner. Only those openings indicated on the Structural Drawings to be cut. Other opening to be cut and reinforced by those requiring the opening as approved by the Structural Engineer.
D. Acoustical Roof Deck:
    1. Fasten acoustical roof decks to all supporting members with two 3/4 inch (19 mm) diameter puddle welds at a nominal spacing of 12 inches (300 mm) on center or less as indicated on the manufacturer's erection drawings.
        a. Fasten the sides of the acoustical roof deck located at the perimeter of the building to supporting members with 3/4 inch (19 mm) diameter puddle welds at a maximum spacing of 36 inches (914 mm) on center or less as indicated on the manufacturer's erection drawings.
    2. Fasten acoustical roof deck sidelaps together with 1 1/2 inch (38 mm) long fillet welds or #12 screws as indicated on the manufacturer's erection drawings.
E. Do not apply construction loads to acoustical roof deck until after the panels are permanently fastened to supporting members and sidelaps are attached; ensure loads do not exceed the load-carrying capacity of the panels.
F. Do not suspend items such as light fixtures, conduit, pipe, and ductwork from acoustical roof deck without specific approval of the Structural Engineer.
G. Fasten sump pans, ridge plates, valley plates, transition plates, eave plates, and supplied reinforcement for small openings as indicated on the manufacturer's erection drawings.
H. After the erection is complete, the Architect and/or Structural Engineer shall review all structural steel.

3.03 PROTECTION AND CLEANING

A. Avoid construction loads that could damage the acoustical roof deck such as heavy concentrated loads and impact loads. Use planking in all high traffic areas.
B. Galvanizing and other coatings that are damaged must be field repaired using appropriate methods and shall be the responsibility of the contractor.
C. Clean the bottom surface of the acoustical roof deck for field painting.

END OF SECTION 05 3400

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SECTION 05 4000

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Cold-Formed Metal Framing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Formed steel stud structural steel canopies and interior wall framing.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 3100 - Steel Decking.
B. Section 06 1000 - Rough Carpentry: Wood blocking and miscellaneous framing.
C. Section 07 2100 - Thermal Insulation: Insulation within framing members.
D. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
E. Section 07 6200 - Sheet Metal Flashing and Trim: Head and sill flashings.
F. Section 09 5100 - Acoustical Ceilings: Ceiling suspension system.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2018).
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
E. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.
F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
H. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, and limitations .
C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
    1. Describe method for securing studs to tracks and for bolted framing connections.
    2. Design data:
E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .
F. Designer's Qualification Statement.
G. Manufacturer's Qualification Statement.
H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before the start of scheduled welding work.
I. SSMA Manufacturer Qualification: Submit documentation of manufacturer association membership.
J. SSFSA Manufacturer Qualification: Submit documentation of manufacturer association membership.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
C. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com.
D. Manufacturer Qualifications: Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com.
E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.
F. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of documented experience and approved by manufacturer.

1.07 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
    1. CEMCO: www.cemcosteel.com.
    2. ClarkDietrich Building Systems: www.clarkdietrich.com.
    3. Jaimes Industries: www.jaimesind.com.
    4. Marino: www.marinoware.com.
    5. R-stud, LLC: https://rstud.biz.
    6. SCAFCO Corporation: www.scafco.com.
    7. Steel Construction Systems: www.steelconsystems.com.
    8. The Steel Network, Inc: www.SteelNetwork.com.

9. Metal Sales Corp.: www.metalsales.us.com.
10. Substitutions: See Section 01 6000 - Product Requirements.

B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
   2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: In accordance with applicable codes.
   4. Live load deflection meeting the following, unless otherwise indicated:
      a. Exterior Walls: Maximum horizontal deflection under wind load shall conform to IBC Table 1604.3
      b. Design non-axial loadbearing framing to accommodate no less than 1/2 in vertical deflection.
   5. Framing system should be able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
   6. Framing system should be able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
C. Shop fabricate framing system to the greatest extent possible.
D. Deliver to project site in largest practical sections.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
   1. Gauge and depth: As indicated on the Drawings, but no lighter than 43 mil exterior and 33 mil interior.
   2. Galvanized in accordance with ASTM A653/A653M.
      a. G90 Exterior Walls.
      b. G60 Interior Wet Areas.
      c. G40 Interior Dry Areas.
   3. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).
B. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating and factory punched holes and slots .
   2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
      a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.

b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
d. Acceptable Products: VertiClip(r) or DriftClip(tm) manufactured by The Steel Network Inc.

4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
B. Anchorage Devices: Powder actuated, Drilled expansion bolts, and Screws with sleeves.
C. Welding: In conformance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.

2.05 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing components are ready to receive work.
B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

A. Install components in accordance with ASTM C1007 requirements and ASTM C1007 requirements.
B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
E. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
F. Install load-bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
H. Install intermediate studs above and below openings to align with wall stud spacing.
I. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
J. Attach cross studs to studs for attachment of fixtures anchored to walls.
K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
L. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.
C. Locate joist end bearing directly over load-bearing studs or provide load distributing member to top of stud track.

3.04 TOLERANCES

A. Maximum Variation from True Position: 1/8 inch.
B. Maximum Variation of any Member from Plane: 1/8 inch.

END OF SECTION 05 4000

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SECTION 05 5000

METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Metal Fabrication work as indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. All required channels, tubes, angles, bent plates and headed stud anchors required for all stairway construction.
C. All required steel lintels.
D. Stairs.
    1. Tube stringers.
    2. Plate steel risers and treads.
    3. Stainless steel riser.
E. Steel roof access ladders and elevator pit ladders.
    1. Galvanized at exterior conditions.
    2. At height conditions of 24 feet (7.3 m) or higher and/or as shown on drawings provide OSHA approved safety cage.
    3. Ladder guard.
    4. OSHA required deflector plate at roof access hatch.
F. Support angles or bent plates at wall furring.
G. Metal flat strap to bridge installation of window system.
H. Formed metal gratings, including perimeter closure.
I. Flat surface floor and stair tread plating.
J. Miscellaneous steel angles, plates and anchors as required.
K. Shop fabricated steel and aluminum items.
L. Fabricated aluminum tube device bollards.
M. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
B. Section 04 2900 - Engineered Unit Masonry: Placement of metal fabrications in masonry.
C. Section 05 1200 - Structural Steel Framing: Structural steel column anchor bolts.
D. Section 05 2100 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
E. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
F. Section 05 7300 - Decorative Metal Railings.
G. Section 07 9513 - Expansion Joint Cover Assemblies.
H. Section 09 9113 - Exterior Painting: Paint finish.
I. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2021.

C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2021.
D. {RSTEMP#36}AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels{CH#29074}.
E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
F. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.
I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
K. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
M. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
N. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
O. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
P. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
Q. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
R. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).
S. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
T. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
U. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.
V. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
W. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
X. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
Y. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
Z. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
AA. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
BB. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
CC. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
DD. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

EE. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
FF. NAAMM MBG 531 - Metal Bar Grating Manual; 2017.
GG. NAAMM MBG 532 - Heavy Duty Metal Bar Grating Manual; 2019.
HH. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
II. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
JJ. SSPC-SP 3 - Power Tool Cleaning; 2018.
KK. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide span and deflection tables for metal grating systems and flat surface floor and stair tread plating.
C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
    1. For metal grating systems and flat surface floor and stair tread plating, indicate details of component supports, openings, perimeter construction details, and tolerances.
    2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
D. Samples: For metal gratings and flat surface floor and stair tread plating, submit two samples, 12 by 12 inch in size illustrating surface finish, color, and texture.
E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
F. Designer's Qualification Statement.
G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172 or AISC 201.
H. Manufacturer's Installation Instructions: Indicate special requirements for opening and perimeter framing.

1.05 QUALITY ASSURANCE

A. Design shall be under direct supervision of a Professional Structural Engineer experienced in design the of this type of Work and licensed in the State in which the Project is located.
B. Designer Qualifications, Metal Gratings and Plates: Design gratings and plates under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
D. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

1.06 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel W Shapes and Tees: ASTM A992/A992M (50 KSI).
B. Steel Sections: ASTM A36/A36M.
C. Steel All-thread: ASTM A36/A36M

D. Steel Tubing: ASTM A500/A500M Grade B cold-formed structural tubing.
E. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
F. Plates: ASTM A283/A283M.
G. Steel Floor Plate: ASTM A786/A786M; manufacturer's standard pattern.
H. Sheet Steel for Die Stamping: ASTM A1011/A1011M Designation CS hot-rolled sheet.
I. Steel For Welding or Riveting: ASTM A36/A36M unfinished, of shapes indicated.
J. Steel Sheet for Lock Forming: Hot-dipped galvanized, ASTM A653/A653M, FS Type B, with G90/Z275 coating.
K. Steel Framing: ASTM A36/A36M shapes, unfinished.
L. Cross Bars: ASTM B211/B211M solid bars.
M. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
N. Stainless Steel, General: ASTM A666, Type 304.
O. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
P. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
Q. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
R. Stainless Steel Finish: No. 4 Bright Polished finish.
S. Slotted Channel Fittings: ASTM A1011/A1011M.
T. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.
U. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
V. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
W. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
F. Aluminum-Alloy Die Castings: ASTM B85/B85M.
G. Aluminum For Lock Forming: ASTM B211/B211M bars, shapes as indicated.
H. Bolts, Nuts, and Washers: Stainless steel.
I. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.
B. Fabricate items with joints tightly fitted and secured.
C. Continuously seal joined members by continuous welds.
D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
F. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
G. Metal Grating Systems and Platings:
    1. Grating Type: NAAMM MBG 531, Pressure Locked Type.
    2. Grating Type: NAAMM MBG 532, Pressure Locked Type.

3. Fabricate grates and plates to accommodate design loads.
4. Mechanically clinch joints of intersecting metal sections.
5. Fabricate support framing for openings.
6. Top Surface: Serrated.

2.04 FABRICATED ITEMS

A. Lintels: As scheduled on Structural Drawings; galvanized finish.
B. Door Frames for Overhead Door Openings and Wall Openings: Channel and Angle sections; prime paint finish or galvanized finish at exterior conditions.

2.05 METAL GRATINGS AND PLATINGS

A. Manufacturers
   1. Ross Technology Corporation: www.rosstechnology.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.
B. Performance Requirements
   1. Comply with applicable code for loading requirements.
   2. Load Design: NAAMM MBG 531.
   3. Design Live (Pedestrian) Load: Uniform load of 100 lb/sq ft minimum; concentrated load of 300 lbs.
   4. Maximum Allowable Deflection Under Live Load: 1/240 of span; size components by single support design.
   5. Maximum Spacing Between Bars: To restrict pedestrian shoe heels.
C. Materials
   1. Sheet Steel for Die Stamping: ASTM A1011/A1011M Designation CS hot-rolled sheet.
   2. Steel For Welding or Riveting: ASTM A36/A36M unfinished, of shapes indicated.
   3. Steel Sheet for Lock Forming: Hot-dipped galvanized, ASTM A653/A653M, FS Type B, with G90/Z275 coating.
   4. Steel Framing: ASTM A36/A36M shapes, unfinished.
   5. Aluminum For Lock Forming: ASTM B211/B211M bars, shapes as indicated.
   6. Cross Bars: ASTM B211/B211M solid bars.
   7. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
   8. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
   9. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
D. Accessories
   1. Fasteners and Saddle Clips: Galvanized steel.
   2. Perimeter Closure: Of same material as grating.

2.06 FINISHES - METAL GRATING AND PLATING

A. Prepare surfaces to be primed in accordance with SSPC-SP 2.
B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
C. Do not prime surfaces in direct contact with concrete or where field welding is required.
D. Prime paint items with one coat.
E. Galvanizing for Steel Shapes: ASTM A123/A123M.
F. Galvanizing for Steel Hardware: ASTM A153/A153M.
G. Non-Slip Surfacing: Aluminum oxide.

2.07 FINISHES - STEEL

A. Prime paint steel items.

1. Exceptions: Galvanize items to be embedded in concrete, items to be imbedded in masonry, and items specified for galvanized finish.
2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP 3Power Tool Cleaning.
C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
D. Prime Painting: One coat.
E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
1. Located at exterior conditions.

2.08 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I color anodized.
B. Interior Aluminum Surfaces: Class I natural anodized.
C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41. Clear anodic coating not less than 0.7 mils thick.
D. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31. Clear anodic coating not less than 0.4 mils thick.
E. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42. Integrally colored anodic coating not less than 0.7 mils thick; light bronze.
F. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44. Electrolytically deposited colored anodic coating not less than 0.7 mils thick; light bronze.
G. Class II Color Anodized Finish: AAMA 611 AA-M12C22A34. Electrolytically deposited colored anodic coating not less than 0.4 mils thick; light bronze.
H. Pigmented Organic Coating System: AAMA 2603 polyester or acrylic baked enamel finish; color as indicated.
I. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as indicated.
J. Superior Performance Organic Coating System: {RS#36} multiple coat, thermally cured polyvinylidene fluoride system; color as indicated.
K. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.
1. Epoxy paint or self adhered waterproof membrane may also be used.

2.09 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.
B. Maximum Offset Between Faces: 1/16 inch.
C. Maximum Misalignment of Adjacent Members: 1/16 inch.
D. Maximum Bow: 1/8 inch in 48 inches.
E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Verify that opening sizes and dimensional tolerances are acceptable.
C. Verify that supports are correctly positioned.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.
B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.
B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
C. Field weld components as indicated on shop drawings.
D. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Obtain approval prior to site cutting or making adjustments not scheduled.
F. After erection, prime welds, abrasionsand surfaces not shop primed or galvanized , except surfaces to be in contact with concrete.
G. Metal Gratings and Floor Plates:
    1. Install components in accordance with manufacturer's instructions.
    2. Place frames in correct position, plumb and level.
    3. Mechanically cut galvanized finish surfaces. Do not flame cut.
    4. Anchor by welding.
    5. Set perimeter closure flush with top of grating and surrounding construction.
    6. Secure to prevent movement.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.
C. Maximum Out-of-Position: 1/4 inch.
D. For Metal Gratings and Floor Plates:
    1. Comply with NAAMM MBG 531.
    2. Comply with NAAMM MBG 532.

END OF SECTION 05 5000

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SECTION 05 7300

DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Decorative Metal Railing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Stainless steel railing and guardrail assemblies.
C. Stainless steel handrails.
D. Do not include sales tax, refer to Section 00 0104 - Notice to Contractors

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors in concrete.
B. Section 04 2001 - Masonry Veneer: Placement of anchors in masonry.
C. Section 04 2731 - Reinforced Unit Masonry: Placement of anchors in masonry.
D. Section 05 5000 - Metal Fabrications: Supports.
E. Section 05 5100 - Metal Stairs: Handrails other than those specified in this section.
F. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
D. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
E. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
F. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
G. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
H. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).
I. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section.
    1. Attendees shall include, but not be limited to:
        a. Contractor.
        b. Manufacturer's representative.
        c. Architect.
        d. School District representative.
        e. Other subcontractors of adjacent work.
    2. Review the following:

a. Installation methods for frame components attaching to supporting construction.
b. Installation, adjusting, and protection of railing assembly.
c. Coordination of other work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
D. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
E. Samples:
   1. Provide one 24 inch long railing system sample showing post, top rail, hand rail, and glass infill.
   2. Provide one wall mounted handrail bracket.
F. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
G. Manufacturer's Installation Instructions.
H. Maintenance Data: Manufacturer's instructions for care and cleaning.
I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Salt Lake City School District's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing glazed railing systems and acceptable to manufacturer.
B. Railing System:
   1. System Components: Pre-engineered, designed by licensed Professional Structural Engineer.
   2. Attachments to the Building Structure: Designed by Professional Structural Engineer licensed in the State of Utah.
C. Perform work in accordance with ASTM E985.

1.07 MOCK-UP

A. Provide mock-up of railing system and wall mounted handrail, minimum 48 inches long by full height.
   1. Show framing, infill, attachments, and accessories.
   2. Locate where directed by Architect.
   3. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver railing materials in factory provided protective coverings and packaging.
B. Protect railing materials against damage during transit, delivery, storage, and installation at site.
C. Inspect railing materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
D. Prior to installation, store materials and components under cover, in a dry location.

1.09 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees Fahrenheit and maximum 95 degrees Fahrenheit.
B. Maintain ambient temperature of space at minimum 65 degrees Fahrenheit and maximum 95 degrees Fahrenheit for 24 hours before, during, and after railing installation.

1.10 WARRANTY/GUARANTEE

A. Warranty: Manufacturer's standard warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.
B. The Contractor shall guarantee his work for a period of One (1) years from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 RAILINGS

1. Railings - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
    a. Design Criteria: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
        1) Lateral Force: 75 lb minimum, at any point, when tested in accordance with ASTM E935.
    b. Distributed Load: 50 pounds per foot minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.
    c. Concentrated Loads on Intermediate Rails: 50 pounds per square ft, minimum.
    d. Concentrated Load: 200 pounds minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
4. Field Connections: Provide sleeves to accommodate site assembly and installation.
5. Welded Joints: Make exposed joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
    a. Ease exposed edges to small uniform radius.
6. Finish: Stainless Steel and Powder Coated.

B. Handrails:
1. 1-1/2 inch diameter stainless steel; No. 6 Satin..
2. Internal Connection Sleeves: Sleeve, material compatible with handrail material.
3. Elbows: Preformed mandrel bent elbows without seams.
4. Posts: 1-1/2 inch diameter stainless steel; No. 6 satin finish.
5. Handrail Brackets: Stainless steel brackets.
    a. Mounting: Wall.
    b. Finish: No. 6 satin finish.

C. Guard Rail Mesh
1. McNichols Aura #8150; http://www.mcnichols.com/arch/specSheets/Aura8150.pdf

2.02 MATERIALS

A. Stainless Steel:
1. Stainless Steel Shapes: ASTM A240/A240M, Type 304 or Type 316.

2. Stainless Steel Tubing: ASTM A554, Type 304 or Type 316.
3. Stainless Steel Finish: NAAMM AMP 500-06; No. 6 Satin.

B. Steel:
1. Steel Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black finish.
2. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
3. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC-SP 2 "Hand Tool Cleaning" or SSPC-SP 3 “Power Tool Cleaning" as needed.

2.03 ACCESSORIES

A. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.
C. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
1. For anchorage to concrete, provide inserts to be cast into concrete for bolting anchors.
2. For anchorage to masonry, provide brackets to be embedded in masonry for bolting anchors.
3. For anchorage to stud walls, provide backing plates for bolting anchors.
4. Posts: Provide adjustable flanged brackets.
5. Exposed Fasteners: No exposed bolts or screws.

D. Hydraulic Expansion Cement: ASTM C1107/C1107M.
1. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch dry film thickness per coat..
2. Sealant: Silicone; clear.
3. Finish Touch-Up Materials: As recommended by manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.
B. Verify field dimensions of locations and areas to receive work.
C. Notify Architect immediately of conditions that would prevent satisfactory installation.
D. Do not proceed with work until detrimental conditions have been corrected.
E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.02 PREPARATION

A. Protect existing work.
B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
C. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
C. Anchor securely to structure.
D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
E. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.
C. Maximum Out-of-Position: 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING

A. Remove protective film from exposed metal surfaces.
B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

3.07 PROTECTION

A. Protect installed components and finishes from damage after installation.
B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
    1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION 05 7300

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SECTION 06 1000

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Rough Carpentry work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Sheathing.
C. Roof-mounted curbs.
D. Roofing nailers and parapet caps.
E. Preservative treated wood materials.
F. Fire retardant treated wood materials.
G. Miscellaneous framing and sheathing.
H. Communications and electrical room mounting boards.
I. Concealed and miscellaneous wood blocking, nailers, and supports.
J. Miscellaneous wood nailers, furring, and grounds.
K. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Sill flashings.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
B. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
D. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2021.
F. PS 1 - Structural Plywood; 2009 (Revised 2019).
G. PS 20 - American Softwood Lumber Standard; 2021.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide on all products including technical data on wood preservative materials.
C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.06 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Treated Douglas Fir-Larch , unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

2.02 CONSTRUCTION PANELS

A. Miscellaneous Sheathing:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C, Plugged or better, Exterior grade. 3/4 inch (19 mm) thick.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. Manufacturers:
      a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
      b. Hoover Treated Wood Products, Inc: www.frtw.com.
      c. Osmose, Inc: www.osmose.com.
      d. Viance, LLC; D-Blaze: www.treatedwood.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
    a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    b. Treat exterior rough carpentry items.
    c. Do not use treated wood in direct contact with the ground.
3. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    b. Treat rough carpentry items as indicated .
    c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
C. Install structural members full length without splices unless otherwise specifically detailed.
D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
E. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
F. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.03 MISCELLANEOUS FRAMING, BLOCKING, NAILERS, SUPPORTS, AND SHEATHING

A. Provide framing, blocking, and sheathing members as indicated or as required.

3.04 INSTALLATION OF CONSTRUCTION PANELS

3.05 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 CLEANING

A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 1000

SECTION 06 4100

ARCHITECTURAL CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Architectural Casework work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Plastic Laminate Casework.
C. Plastic Laminate Faced Wall Panels
D. Countertops.
    1. Plastic Laminate.
E. Casework hardware.
F. Shelving, shelf standards, brackets, and accessories.
G. Workstation/Counter Support Brackets
H. Structural supports incorporated into wood casework.
I. Factory finishing.
J. Preparation for installing utilities.\
K. Steel in wall brackets
L. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
B. Section 06 6116 - Solid Surfacing Fabrications: Countertops.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2016.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2016.
C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
E. BHMA A156.9 - Cabinet Hardware; 2020.
F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
    1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
    2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) Section 1 - Submittals
    3. Include certification program label.
    4. Field verify all room dimensions as a part of manufacturing casework.
C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.05 QUALITY ASSURANCE

A. Millwork and installation shall be in accordance with Premium Grade or Custom Grade of the Architectural Woodwork Standards, latest edition. If provisions for the Grade specified are in conflict with, or modified by the drawings and/or specifications, the modifications shall govern.
B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
    1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.

1.06 MOCK-UP

A. Provide mock-up of typical base cabinet, wall cabinet, countertop, and base cabinet with at least one drawer, including hardware, finishes, and plumbing accessories of each type of casework specified.
B. See Section 01 4300 - Quality Assurance for additional requirements.
C. Locate where directed.
D. Mock-up may remain as part of the Work, if undisturbed at time of substantial completion at the discretion of the Architect.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.
B. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.
    1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
C. Any damage to casework during installation will be properly repaired or replaced.

1.08 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

1.09 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 FABRICATORS/INSTALLERS

A. Subject to compliance with requirements, provide products and labor by one of the following:
    1. Fetzer's Architectural Woodwork, Inc, Salt Lake City, UT, (801) 484-6103.
    2. Fondell Woodwork, Inc, Lehi, UT, (801) 768-4467.
    3. Granite Mill, Inc., Salt Lake City, UT, (801) 467-3222.
    4. Huetter Mill, Murray, UT, (801) 266-3222.
    5. Advanced Cabinets LLC, Midvale, Utah (801) 251-0155
    6. Johnson Brothers Mill, Idaho Falls, ID, (208) 522-3674.
    7. Artistic Mill, Murray, UT, (801) 262-8851.

8. Mapleleaf Cabinets, Salt Lake City, UT, (801) 262-7741.
9. Cozzens Cabinets, Cedar City, Ut (435) 586-7618
10. Substitutions: See Section 01 6000 - Product Requirements.

B. Single Source Responsibility: A single millwork fabricator/installer shall provide and install the work of this Section and Section 06 2000 - Finish Carpentry.

2.02 CABINETS

A. Seismic-Compliant Construction: Comply with all requirements of Seismic Design Category D, ICC (IBC).

B. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
1. Cabinet Color: Wilsonart High Line 7970.
2. Administrative Areas, Media Center, Counseling Areas, Faculty Areas, Other Areas as indicated: Premium Grade.
3. Classrooms, Workrooms, Storage Rooms, Breakrooms, Custodial Rooms, Utility Rooms, Other Areas as indicated: Custom Grade.
4. No Economy Grade Cabinets Accepted.

C. Plastic Laminate Faced Cabinets: Premium grade.
1. Exposed Exterior/Interior Surfaces: HDPL, Type VGS.
2. Semi-Exposed Surfaces: HDPL, Type CLS.
3. Concealed Surfaces: HDPL, Type BKL
4. Construction Type: A - Frameless.
5. Interface Style: 1 - Overlay.
6. Doors, Drawer Fronts, and False Fronts: Flush Overlay.
    a. Edgeband: Through-Color ABS Edgebanding to match laminate patterns and colors.
        1) Basis of Design Manufacturer: Wilsonart.
        2) Other Manufacturers:
            (a) Doellken (if exact match is available).
            (b) Charter Industries (if exact match is available).
        3) Substitutions: See Section 01 6000 - Product Requirements.
    b. Edge Profile: Radius edge with thick applied band.
7. Hinges: See Hinges below.
    a. Door edges shall be notched for hinges in order to maintain proper gap tolerance.
8. Core Material: refer to Core Material sub-section below

D. Plastic Laminate Faced Cabinets: Custom grade.
1. Exposed Exterior/Interior Surfaces: HDPL, Type VGS.
2. Semi-Exposed Surfaces: HDPL, Type CLS.
3. Casework Construction Type: Type A - Frameless.
4. Interface Style: 1 - Overlay.
5. Doors, Drawer Fronts, and False Fronts: Flush Overlay.
    a. Edgeband: Through-Color ABS Edgebanding to match laminate patterns and colors.
        1) Basis of Design Manufacturer: Wilsonart
        2) Other Manufacturers :
            (a) Doellken (if exact match is available)
            (b) Charter Industries (if exact match is available)
        3) Substitutions: See Section 01 6000 - Product Requirements.
    b. Edge Profile: Radius edge with thick applied band.
6. Hinges: See Hinges below.
    a. Door edges shall be notched for hinges in order to maintain proper gap tolerance.
7. Core Material: Refer to Core Material sub-section below.

E. Toe Kick Finish: Rubber, tile, vinyl, or other finished base shall be furnished and installed by others.
F. Fixed and Adjustable Shelving:
    1. All shelving is 1 inch (25 mm) thick, no exceptions.

2.03 CORE MATERIALS

A. Manufacturers:
    1. Roseburg; http://www.roseburg.com/
    2. Columbia Forest Products; www.columbiaforestproducts.com.
    3. States Industries; www.statesind.com.
    4. Substitutions: See Section 01 6000 - Product Requirements.
B. Core Materials:
    1. Combination Core: ANSI A208.1 or ANSI A208.2; composed of engineered MDF composite crossbands combined with inner plies of veneer core.
        a. Provide products having no added urea-formaldehyde resins.
    2. Water Resistant Medium Density Fiberboard (MDF): ANSI A208.2, industrial grade MDF; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as indicated.

2.04 LAMINATE MATERIALS

A. Manufacturers:
    1. Basis of Design: Wilsonart: www.wilsonart.com.
    2. Other Manufacturers:
        a. Pionite; www.panolam.com/pionite.
        b. Formica Corporation: www.formica.com.
        c. Panolam Industries International, IncNevamar: www.nevamar.com.
        d. Substitutions: See Section 01 6000 - Product Requirements.
B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
C. Provide specific types as follows:
    1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors/patterns as selected from manufacturer's full line (including premium), finishes as selected from manufacturer's full range.
    2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors/patterns as selected from manufacturer's full line (including premium), finishes as selected from manufacturer's full range.
    3. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors/patterns as selected from manufacturer's full line, finishes as selected from manufacturer's full range.
    4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.
D. ABS/PVC Edgebanding: Through-Color ABS/PVC Edgebanding to match laminate patterns and colors.
    1. 0.5 mm thick at Case Bodies.
    2. 3 mm thick at Doors, Drawer Fronts, False Fronts, and Shelves.
    3. Manufacturers:
        a. Wilsonart International, Inc: www.wilsonart.com.
        b. ReHau, Inc: www.rehau.com.
        c. Substitutions: See Section 01 6000 - Product Requirements.

2.05 COUNTERTOPS

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI Architectural Woodwork Standards for Grades corresponding with Casework Quality Grades.
B. Solid Surface Countertops: Refer to Section 06 6116 - Solid Surfacing Fabrications.
C. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
    1. Join lengths of tops using best method recommended by manufacturer.
        a. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
    2. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
        a. Return laminate under substrate to back of vertical face of cabinet, fully capsulating the substrate.
D. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
    1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
    2. Height: 4 inches, unless otherwise indicated.
E. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces, finished to match.
F. Plastic Laminate Countertops: High pressure decorative laminate sheet bonded to substrate.
    1. Laminate Sheet: HPDL, Type HGS.
        a. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
        b. Laminate Core Color: Same as decorative surface.
    2. Front Edge Treatment: Postformed laminate; front edge substrate built up to minimum 1-1/4 inch (32 mm) thick with square self edge.
        a. Return laminate under substrate to back of vertical face of cabinet, fully capsulating the substrate.
    3. Back Splash: Self-edge, square butt splash, 4 inches (100 mm) above deck.
    4. Supporting Substrate: Medium Density Fiberboard.
        a. Use Water Resistant Medium Density Fiberboard at Wet Locations.

2.06 ACCESSORIES

A. Adhesives: Type recommended by WI to suit application.
B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel finish in exposed locations.
C. Concealed Joint Fasteners: Threaded steel.
    1. Hot glue and dowels.
    2. Threaded steel.
D. Grommets: Standard plastic or rubber grommets for cut-outs, in color to blend with adjacent surface. Color to be selected by Architect from manufacturer's full color line.
E. Silicone Sealant: ASTM C920, Grade NS, Class 25, Uses NT, A, G, M , O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
    1. Color: Clear.
    2. Movement Capability: Plus and minus 25 percent.
    3. Service Temperature Range: -65 to 180 degrees F (-54 to 82 degrees C).
    4. Shore A Hardness Range: 15 to 35.
    5. Acceptable Manufacturers: Refer to Section 07 9200 - Joint Sealants.

2.07 HARDWARE

A. Hardware: Meeting all BHMA A156.9 Standards and AWI//AWMAC/WI Architectural Woodwork Standards for Grades indicated.

B. Manufacturers:
   1. Rockford Process Control: www.rockfordprocess.com.
   2. Hardware Resources: www.hardwareresources.com.
   3. Salice America, Inc: www.saliceamerica.com.
   4. Grass America, Inc: www.grassusa.com.
   5. Hettich America, LP: www.hettichamerica.com.
   6. Julius Blum, Inc: www.blum.com.
   7. Accuride International, Inc: www.accuride.com.
   8. Knape & Vogt Manufacturing Company: www.kv.com.
   9. Fellowes Corporation: www.fellowes.com.
   10. Hafele America: www.hafele.com.
   11. Bainbridge Manufacturing, Inc: www.bainbridgestore.com.
   12. Ives (Ingersoll Rand): www.professional.iveshardware.com.
   13. Substitutions: See Section 01 60 00 - Product Requirements.

C. Hinges:
   1. European style concealed, self-closing, adjustable type, BHMA No. 156.9, Grade 2, steel with satin finish.
      a. 165 degree at End Cabinets and Stand Alone Cabinets, 110 degrees everywhere else.
      b. Doors 48 inches and over in height have 3 hinges per door.
      c. Acceptable Product: Series 200 manufactured by Salice America, Inc.

D. Drawer Slides:
   1. General Purpose Drawers: Ball bearing slide with rail/bracket mount, full extension plus 1 inch (25 mm) over travel slides, hold-in detent and a 100 lbs /pair load rating. RoHS compliant and BHMA certified to Grade 1 HD-100. RoHS compliant.
      a. Acceptable Product: 3832E - 3834E manufactured by Accuride.
   2. File Drawers: Ball bearing slide with rail/bracket mount, full extension plus 1 inch (25 mm) over travel slides, hold-in detent and a 100 to 150 lbs/pair load rating. RoHS compliant and BHMA certified to Grade 1 HD-100. RoHS compliant.
      a. Acceptable Product: 4032- 4035 manufactured by Accuride.
   3. Drawer slides shall have a lifetime warranty as offered by the manufacturer

E. Locks with strikes: 2 keys per lock, key all cabinets in same room to one key, rooms keyed different, one master key fits all. review keying requirements and schedules with Owner prior to installation.
   1. Drawer and Door Locks: 5-pin tumbler, complying with ANSI/BHMA A156.11, Grade 1.
   2. Doors and Drawers: 7/8 inch for doors and 7/8 - 1 3/8 inch for drawers.
   3. Finish: Satin Chrome: 26D
   4. Cam type locks are not acceptable
   5. Acceptable Products:
      a. Olympus Lock, Inc; Product - "100DR, 200DW, 329R": www.olympus-lock.com.
      b. CompX National; Product - "National Lock C8178, C8173, C8179": www.compxnet.com.
      c. Hafele America; Product - "232.14 Series": www.hafele.com.
      d. No substitutions allowed.

F. Chain Bolts and Elbow Catches: Chain bolts are 3 inches long, and have an 18 inch pull and an angle strike to secure inactive door on cabinets over 72 inches in height. Elbow catches are used on inactive doors up to and including 72 inches in height.

G. Elbow Catch: Die cast aluminum with clear anodized finish.
H. Drawer and Door Pulls: "U" shaped wire pull, stainless steel with satin finish, 4 inch (100 mm) centers.
I. Adjustable Shelf Supports: Adjustable shelves shall be supported on adjustable shelf supports inserted in shelf holes drilled into the case end or partitions and adjustable on 1 1/2 inch (38 mm) centers. Supports shall be clear nylon, dual-pegged shelf securing clips (no exceptions).
    1. Acceptable Product: Model 3220 - Duel Peg Locking Tongue Support manufactured by Bainbridge Manufacturing, Inc.
J. Coat and Hat Hooks: Shall be cast aluminum with finish as selected by Architect.
    1. Acceptable Product: Ives #405" manufactured by Ives (Ingersoll Rand).
K. Casters: All casters for mobile cabinets shall be 4 inches (102 mm) high swivel casters with 1 1/16 inches (27 mm) tread and locking brakes on two casters per cabinet.
L. Wardrobe Clothes Rod w/ Sockets: Shall be 1 1/16 inch (27 mm) OD. tubing with stainless steel finish. Sockets shall have chrome finish.
M. Hanging File Rods: All “File” type drawers to receive (2) 1/8 inch (3 mm) x 1 inch (25 mm) galvanized steel or aluminum rods w/ steel clips that attach to inner face of drawer box. Allow clearance for hanging folders and label tabs.
N. Workstation/Counter Support Brackets - Heavy Duty - Concealed
    1. A&M Hardware C flat concealed bracket mounted to studs with drywall installed over bracket face.
    2. A&M Hardware C flat concealed bracket mounted to studs with plastic laminate faced installed over bracket face.

PART 3 EXECUTI

3.01 FABRICATION

A. Note: AWI//AWMAC/WI Architectural Woodwork Standards for Premium Grade shall take precedence if any conflict arises with fabrication guidelines below.
B. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
C. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
D. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
E. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
    1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
    2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
F. Matching Wood Grain: Comply with requirements of quality standard for specified Grade and as follows:
    1. Provide center matched panels at each elevation.
    2. Provide sequence matching across each elevation.
    3. Carry figure of cabinet fronts to toe kicks.
G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
H. Toe Kicks: Fixed cabinet toe kicks are constructed of 3/4 inch (19 mm) exterior grade oriented strand board with 2 x 4 inch (50 x 102 mm) fir stringers. Bases are leveled and anchored to the floor in continuous lengths to ensure straight and true lines of casework. Rubber, vinyl, tile or other finished base shall be furnished and installed by others.
I. Laminate Faced Cabinets:

1. Case Body:
    a. Ends: Case ends shall be 3/4 inch (19mm) thick combination core. Exposed exterior cabinet ends shall be laminated with VGS laminate. Concealed ends shall be laminated with BKL laminate. Interior surfaces shall be laminated with CLS laminate. Exposed edges shall be edged with PVC edge-banding. Holes shall be drilled for adjustable shelf supports at 32 mm (1 1/4 inch) centers.
2. Cabinet Top and Bottom:
    a. Base and tall cabinet top and bottoms shall be 3/4 inch (19 mm) thick combination core. Exposed sides shall be laminated with CLS laminate and concealed sides shall be laminated with BKL laminate.
    b. Wall cabinet top and bottom shall be 1 inch (25 mm) thick for all cabinets. Laminated with CLS laminate on both sides.
    c. All edges shall be banded with PVC edge-banding.
3. Fixed and Adjustable Shelves:
    a. All shelves shall be 1 inch (25 mm) thick combination core board laminated with CLS laminate on both sides.
    b. All exposed edges shall be banded with PVC edge-banding.
    c. All shelves to be adjustable on 1 1/2 inch (38 mm) centers.
4. All exposed shleves shall be 1 inch thick combination core board laminated with VGS on both sides.
5. Cabinet Backs:
    a. Cabinet backs shall be 1/4 inch (6 mm) thick hardboard laminated with CLS laminate for use in cabinets with or without doors and shall be recessed into ends and sides.
    b. Exposed backs shall be 3/4 inch (19 mm) thick combination core with CLS laminate on interior and VGS laminate on exterior surface.
6. Doors and Drawer Fronts:
    a. Plastic Laminate Doors and Drawer Fronts: Plastic laminate doors and drawer fronts shall be 3/4 inch (19 mm) thick with VGS laminate on exterior face and CLS laminate on interior face.
    b. Doors and drawer fronts shall be edged with PVC edge-banding.
7. Drawers:
    a. Drawer box sides, backs, and sub-fronts shall be 5/8 inch (16 mm) thick combination core laminated with CLS laminate. All edges shall be banded with PVC edge-banding.
    b. Drawer bottoms shall be 1/4 inch (6 mm) thick hardboard or combination core laminated with CLS laminate recessed into the sides, backs, and sub-front.
    c. Paper storage drawers shall be fitted with a hood at back of paper retainage and shall have a 1/2 inch (13 mm) thick reinforced bottom.
    d. Drawer fronts shall be mounted with adjusting mechanism to allow complete adjustability and alignment in the field.

3.02 SHOP FINISHING

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
    1. Transparent:
        a. System - 7, Vinyl, Catalyzed.
        b. Stain: As selected by Architect.
        c. Sheen: Satin.
B. Finish components including casework, paneling, and trim at the same time in the same facility

PART 3 EXECUTION

4.01 EXAMINATION

A. Verify adequacy and proper location of any required backing and support framing.
B. Verify that mechanical, electrical, plumbing, and other building components affecting work in this Section are in place and ready.

4.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
B. Secure all cabinets in accordance with Seismic Design Category D requirements, ICC (IBC).
C. Set and secure all casework in place, assuring that they are rigid, plumb, and level.
D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
E. All casework items shall be securely anchored to building structure, except for those items identified as "mobile" or "moveable" on drawings, which are to be adjusted to prevent any rocking when sitting on finish floor.
F. Primary anchorage of base and wall cabinets shall be through the cabinet back into wall framing or blocking furnished under other sections. Additional anchorage will be made into cabinet bases and adjacent side walls where they occur. Appropriate sized anchor screws shall be used to best attach to the existing wall condition which will allow each cabinet to be loaded to a capacity of 50 lbs. per sq. ft. of shelf area.
G. At free-spanning countertops or work surfaces, steel support brackets shall be provided at a maximum spacing of 32 inches (812 mm), or as shown on drawings. Support brackets are to be designed to allow for knee space clearance and attach to wall framing for support.
H. Secure cabinets to floor using appropriate angles and anchorages.
I. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
J. Site glaze glass materials using the Interior Dry method specified in Section 08 8000.
K. Mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end, shall be countersunk.
L. Equipment cutouts shown on plans shall be cut by the installer.

4.03 COORDINATION

A. Verify requirements and location from architect before cutting holes for paper slots and grommets.
B. Provide cutting and fitting as necessary to accommodate mechanical and electrical work built into casework units.
C. Provide alterations to casework to keep devices accessible when they are covered by casework. This includes mechanical and electrical switches, receptacles, panels, access doors and other devices.

4.04 CAULKING

A. Joint Cleaning: Apply sealant to clean, dry surface free from grease, oil, wax or other foreign matter tending to destroy or impair adhesion. Clean and prime in accordance with sealant manufacturer's instructions if required.
B. Application: Apply sealants strictly in accordance with manufacturer's instructions and supervision, by manufacturer approved applicator. Provide technical field assistance by manufacturers to ensure proper mixing of sealants, cleaning of surfaces and application of materials.

C. Cleaning and Protection: Carefully protect adjoining surfaces from staining. Immediately remove any material on surfaces not to receive sealant and restore finish as required. Where cleaning and restoration is not acceptable, remove affected work and provide new work conforming to applicable requirements as directed at Contractor's expense.
D. Fill joints partially with closed cell expanded backing using only compatible materials until joint width does not exceed joint depth. Apply sealant under sufficient pressure to completely fill voids. Finish exposed joints smooth, flush with surface or recessed as shown.

4.05 ADJUSTING AND TOUCH UP

A. Before completion of the installation, the installer shall adjust all moving and operating parts to function smoothly and correctly.
B. All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items that cannot be repaired shall be replaced.
C. Test installed work for rigidity and ability to support loads.

4.06 CLEANING

A. All casework shall be broom cleaned. All debris, including packaging and scraps, shall be removed to the appropriate job waste dump.
B. This Contractor shall clean interiors and exteriors of the cabinets repairing all scratches, buffs, etc., using factory-approved cleaning and polishing solutions.
C. Damaged surfaces which cannot be repaired properly shall be replaced as directed by the Architect and at no additional cost to the Owner.
D. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks and broom clean the area of operation.

SECTION 06 6116

SOLID SURFACING FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Solid Surfacing Fabrication work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Media Center main desk and bookshelf tops.
C. Administration area countertops.
D. Windowsills.
E. Admin Breakroom (undermount sinks as specified in Division 22 - Plumbing).
F. Admin Workrooms.
G. Thresholds.
H. Sealants related to this section.
I. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders

1.02 RELATED REQUIREMENTS

A. Section 05 5000 - Metal Fabrications: Blocking.
B. Section 06 1000 - Rough Carpentry: Blocking.
C. Section 06 4100 - Architectural Wood Casework.
D. Section 09 3000 - Tiling: Installation of thresholds.
E. Division 22 - Plumbing: Plumbing fixtures.
F. Division 26 - Electrical: Electrical fixtures.

1.03 REFERENCE STANDARDS

A. ANSI Z124.3 - American National Standard for Plastic Lavatories; 2005.
B. ANSI Z124.4 - Plastic Water Closet Bowls and Tanks; 2006.
C. ANSI Z124.6 - American National Standard for Plastic Sinks; 2007.
D. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
E. ASTM D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials; 2008 (Reapproved 2015).
F. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
I. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
K. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; 2006.
L. NSF 51 - Food Equipment Materials; 2017.
M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Coordination: Coordinate the installation of solid surface fabrications with size, location and installation of service utilities and casework. Site verify all dimensions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.
C. Shop Drawings:
    1. Show location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components.
        a. Show full-size details, edge details, thermoforming requirements, and attachments.
        b. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
        c. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in solid surface.
    2. Countertops and Splashes: Submit shop drawings in conformance to AWS Section 1 - Submittals. The first page of the original shop drawings shall bear a Woodwork Institute Certified Compliance Label. For further information visit: www.woodworkinstitute.com.
D. Samples: Submit 6 inch by 6 inch (150 mm by 150 mm) sample in specified gloss. Cut sample and seam together for representation of inconspicuous seam.
    1. Indicate full range of color and pattern variation.
E. Maintenance Data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Maintenance kit for finishes.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
B. Fabricator/Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.
C. Countertops and Splashes:
    1. Fabrication and installation shall be in accordance with Premium Grade of the AWI/AWMAC/WI (AWS)
    2. Certified Compliance:
        a. Each countertop shall bear a Woodwork Institute Certified Compliance Label.
        b. Replace, repair, or rework all work for which certification is refused at no cost to the Owner.
        c. It is the responsibility of the fabricator/installer to include within their bid, any and all cost for certified compliance. Issuance of a Certified Compliance Certificate is a prerequisite for final acceptance. For further information visit www.woodworkinstitute.com.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver all solid polymer fabrications to site ready for installation. Deliver in protective packing so as to prevent any potential damage to work prior to installation. Do not deliver any materials to site until areas are ready to receive them for installation. Store all materials indoors in a dry area away from extreme temperatures. Store flat materials in vertical racks with edges protected or flat on padded pallets.

1.08 FIELD CONDITIONS

A. Maintain relative humidity planned for building occupants and an ambient temperature between 65 and 75 degrees F for 48 hours prior to and during installation. After installation, maintain relative humidity and ambient temperature planned for building occupants.

1.09 WARRANTY

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.
B. Provide manufacturer’s warranty against defects in materials.
   1. Warranty shall provide material and labor to repair or replace defective materials.
   2. Warranty Period: Ten years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Corian Solid Surface. https://www.corian.com.
B. Other Acceptable Manufacturers to Include:
   1. Dupont : www.corian.com.
   2. Formica Corporation : www.formica.com.
   3. Avonite Surfaces : www.avonitesurfaces.com.
   4. Wilsonart International, Inc : www.wilsonartcontract.com.
   5. LG hausys; Hi-Macs: www.lghausys.com.
   6. Samsung Staron: www.staron.com.
C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Solid Polymer:
   1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.4, having minimum physical and performance properties specified.
   2. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.
   3. Finish:
      a. Matte; gloss range of 5 - 20.
      b. Provide surfaces with a uniform finish.
   4. Performance Characteristics:
      a. Tensile Strength: 6,000 psi, ASTM D638.
      b. Tensile Elongation: 0.4 percent minimum, ASTM D 638.
      c. Flexural Strength: 10,000 psi, ASTM D790
      d. Hardness: >85, Rockwell "M" Scale - ASTM D785.
      e. Light Resistance: (Xenon Arc) No effect, NEMA LD 3, Method 3.3.
      f. Wear and Cleanability: Passes, ANSI Z124.3 & ANSI Z124.6.
      g. Stain Resistance: Passes, ANSI Z124.3 & Z124.6.

h. Fungus and Bacteria Resistance: Does not support microbial growth,ASTM G21
i. High Temperature Resistance: No Change, NEMA LD 3, Method 3.6.
j. Flammability: Class I and Class A, ASTM E84, NFPA 255, UL 723.
k. Flame Spread Index: <25.
l. Smoke Developed Index: <25.

2.03 COMPONENTS

A. Quality Grade: Unless otherwise indicated provide Countertops and Splashes of quality specified by AWI//AWMAC/WI Architectural Woodwork Standards for Premium Grade.
B. Windowsills: 1/2 inch (13 mm) thick, depth and length as shown on drawings or as indicated by Architect.
   1. Colors: As selected by Architect from Manufacturer's full color line, including premium.
   2. Exposed Edge Treatment: Built up to minimum 1 inch (26 mm) thick; square edge.
C. Thresholds: 3/4 inch (19 mm) thick, depth to match depth of wall and length to match full width of opening (no seams).
   1. Colors: As selected by Architect from Manufacturer's full color line, including premium.
   2. Edge Treatment: 45 degree chamfer at both top edges.
D. Note: Color selections may be different for each component/area. Allow for a minimum of 4 color choices.

2.04 PRODUCTS

A. Basis of Design Products:
   1. **SS1** (Countertops): Corian Solid Surface Artista Canvas.
   2. **SS2** (Windowsills): Corian Solid Surface White Jasmine.
   3. Threshold color to be determined.

2.05 FINISHES

A. Matte; gloss range of 5 - 20.
B. Provide surfaces with a uniform finish.

2.06 ACCESSORIES

A. Joint Adhesive:
   1. Manufacturer's recommended one or two part adhesive kit to create inconspicuous, nonporous joints.
B. Sealant:
   1. Manufacturer's recommended mildew resistant, FDA-compliant, NSF 51 compliant (food zone - any type), UL listed silicone sealant in colors matching components.
C. Sink Mounting Hardware:
   1. Manufacturer's recommended bowl clips, panel inserts and fasteners for attachment of undermount sinks.
D. Conductive Tape:
   1. Manufacturer's recommended aluminum foil tape, with required thickness, for use with cutouts near heat sources.
E. Insulating Felt Tape:
   1. Manufacturer's recommended for use with conductive tape in insulating solid surface material from adjacent heat source.

2.07 FACTORY FABRICATION

A. Fabricate Countertops and Splashes in conformance with the Architectural Woodwork Standards, latest edition.

1. Conform to AWS Premium Grade.

B. Shop Assembly:
   1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings, field measurements, and manufacturer's printed instructions and technical bulletins.
   2. Form joints between components using manufacturer's recommended joint adhesive without conspicuous joints.
      a. Reinforce with strip of solid polymer material, 2 inches (51 mm) wide.
   3. Provide factory cutouts for plumbing fittings as indicated on the drawings.
   4. Rout and finish component edges with clean, sharp returns.
      a. Rout cutouts, radii and contours to template.
      b. Smooth edges.
      c. Repair or reject defective and inaccurate work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Countertops and Splashes in conformance with the AWI/AWMAC/WI (AWS)
   1. Installation shall conform to AWS Premium Grade.
B. Install other components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
   1. Provide product in the largest pieces available.
   2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
   3. Exposed joints/seams shall not be allowed.
   4. Reinforce field joints with solid surface strips extending a minimum of 1 inch (25 mm) on either side of the seam with the strip being the same thickness as the top.
   5. Cut and finish component edges with clean, sharp returns.
   6. Rout radii and contours to template.
   7. Anchor securely to base cabinets or other supports.
   8. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
   9. Carefully dress joints smooth, remove surface scratches and clean entire surface.
   10. Install countertops with no more than 1/8 inch (3 mm) sag, bow or other variation from a straight line.
C. Applied Splashes:
   1. Install applied splashes using manufacturer's standard color matched silicone sealant.
   2. Adhere applied splashes to countertops using manufacturer's standard color matched silicone sealant.
D. Coved Splashes:
   1. Provide coved splashes at all walls and adjacent millwork.
   2. Fabricate radius cove at intersection of counters with splashes to dimensions shown on drawings or as directed by the Architect.
   3. Adhere to countertops using manufacturer's standard color matched Joint Adhesive.
E. Windowsills:

1. Install windowsills full length of window, set securely into place using only concealed fasteners and manufacturer's recommended adhesive.
2. Windowsills shall be plumb, true and level.
3. Provide minimum of 1/8 inch (3 mm) expansion gaps on both sides of sill, sealed with manufacturer's recommended sealant.

F. Thresholds:
1. Installed by Section 09 3000 - Tiling.

3.03 REPAIR

A. Repair or replace damaged work which cannot be repaired to Architect's satisfaction.

3.04 CLEANING AND PROTECTION

A. Keep components clean during installation.
B. Remove adhesives, sealants and other stains.

END OF SECTION 06 6116

SECTION 07 1300

BELOW GRADE SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Sheet Waterproofing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Waterproofing:
    1. Sheet Waterproofing:
        a. Self-adhered modified bituminous sheet membrane.
C. Protection board
D. Prefabricated drainage composite.
E. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 1000 - Concrete Forming and Accessories.
B. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate and waterstops.
C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal parapet, coping, and counterflashing.
D. Section 07 9200 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not required to be treated in this section.

1.03 REFERENCE STANDARDS

A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).
B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
C. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).
D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
E. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
F. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008, with Editorial Revision (2015).
G. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
H. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2018.
I. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2020.
J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2021.
K. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).
L. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
   1. Establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturer’s product data, installation instructions, use limitations and recommendations.
C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
D. Samples: Submit one 6 inch by 6 inch (150 mm by 150 mm) sample of the following for approval:
   1. Sheet membrane.
   2. Protection board
   3. Prefabricated drainage composite.
E. Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Cache County School District 's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer: Sheet membrane waterproofing system shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of self-adhesive sheet membrane waterproofing. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.
B. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by the manufacturer.
D. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.

1.07 MOCK-UP

A. Construct mock-up consisting of 100 sq ft of horizontal waterproofed panel; to represent finished work including internal and external corners.
B. Locate where directed.
C. Mock-up may remain as part of this Work.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer’s instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
2. Protect mastic and adhesive from moisture and potential sources of ignition.
3. Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.
4. Protect surface conditioner from freezing.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.09 FIELD CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
C. Provide five year manufacturer warranty from date of Substantial Completion for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.01 WATERPROOFING APPLICATIONS

A. Self-Adhered Sheet Waterproofing:
   1. Use at the following areas:
      a. All exterior below grade walls with a depth of greater than 2 feet.
   2. Cover with drainage composite.
   3. Cover with protection board.

B. Including tunnel wall and foundation wall on Gride Line H.

2.02 MEMBRANE MATERIALS

A. Self-Adhered Sheet Membrane: Self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film.
   1. Tensile Strength:
      a. Film: 5,000 psi, minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches per minute.
      b. Membrane: 325 psi, minimum, measured in accordance with ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
   2. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
   3. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
   4. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
   5. Peel Strength: 7 lb per inch, minimum, when tested in accordance with ASTM D903.
   6. Lap Adhesion Strength: 5 lb per inch, minimum, when tested in accordance with ASTM D1876.
   7. Puncture Resistance: 50 lb, minimum, measured in accordance with ASTM E154/E154M.

8. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
9. Hydrostatic Resistance: Resists the weight of 200 ft when tested in accordance with ASTM D5385/D5385M.
10. Surface Conditioner, Mastic, Liquid Membrane, Adhesives, Sealants, Tapes, Waterstops, and Accessories: As recommended by membrane manufacturer.
11. Manufacturers:
    a. Sika - "SikaBit"; www.sika.com
    b. Carlisle Coatings & Waterproofing Incorporated; Product - "MiraDRI 860/861": www.carlisle-ccw.com.
    c. GCP Applied Technologies; Bituthene® System 4000: www.gcpat.com.
    d. W.R. Meadows, Inc; Product - "Mel-Rol": www.wrmeadows.com.
    e. Henry Company; Product - "Blueskin WP 100 Basic": www.henry.com.
    f. Substitutions: See Section 01 6000 - Product Requirements.

B. Surface Conditioner/Primer: As recommended by membrane manufacturer.

2.03 ACCESSORIES

A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic and acceptable to membrane manufacturer.
   1. Extruded polystyrene foam core with tough plastic capsheets on both sides. 1/4 inch thick.
   2. Manufacturers:
      a. Mar-flex Waterproofing & Building Products; Shockwave: www.mar-flex.com.
      b. W.R. Meadows, Inc; Protection Course: www.wrmeadows.com.
      c. Kingspan Insulation LLC; GreenGuard www.trustgreenguard.com.
C. Drainage/Protection Composite Panel: Preformed geocomposite drainage sheet system.
   1. Composition: Hollow studded polystyrene core; covered on one side with a nonwoven, needle punched polypropylene filter fabric and on the other side with a smooth polymeric film.
      a. Manufacturers:
         1) GCP Applied Technologies; Hydroduct 220/660: www.gcpat.com.
         2) Carlisle Coatings & Waterproofing Incorporated; Product - "CCW MiraDrain 6000": www.carlisle-ccw.com.
         3) W.R. Meadows, Inc; Product - "Mel-Drain": www.wrmeadows.com.
         4) Henry; Product - "Henry DB": www.henry.com.
         5) Substitutions: See Section 01 6000 - Product Requirements.
D. Flexible Flashings: Type recommended by membrane manufacturer.
E. Sealants: Type recommended by membrane manufacturer.
F. Counterflashings: See Section 07 6200.
G. Termination Bars: Aluminum; compatible with membrane and adhesives.
H. Adhesives: As recommended by membrane manufacturer.
I. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

PART 3 EXECUTION

3.01 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.
B. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.
B. Cast-In-Place Concrete Substrates:
    1. Do not proceed with installation until concrete has properly cured and dried (minimum 7 days for normal structural concrete and minimum 14 days for lightweight structural concrete).
    2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
    3. Repair bugholes over 13 mm (0.5 in.) in length and 6 mm (0.25 in.) deep and finish flush with surrounding surface.
    4. Remove scaling to sound, unaffected concrete and repair exposed area.
    5. Grind irregular construction joints to suitable flush surface.
C. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.
D. Protect adjacent surfaces from damage not designated to receive waterproofing.
E. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
F. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
G. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
    1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
    2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.
    3. Remove and replace areas of defective concrete as specified in Section 03 3000.
    4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in the referenced standard.
    5. Test concrete surfaces as described in the referenced standards. Verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.03 INSTALLATION - SHEET MEMBRANE WATERPROOFING SYSTEM

A. Refer to manufacturer's literature for installation, including but not limited to, the following:
    1. Apply surface conditioner at rate instructed by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of surface conditioner.
    2. Delay application of membrane until surface conditioner is completely dry. Dry time will vary with weather conditions.

3. Seal daily terminations with troweled bead of mastic.
4. Apply protection board and related materials in accordance with manufacturer's written instructions.

B. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
C. Roll out membrane, and minimize wrinkles and bubbles.
D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
G. Coordinate with drain installation;
H. Install at building expansion joints at locations as indicated on drawings.
I. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
J. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE/PROTECTION COMPOSITE PANEL

A. Install composite panel in accordance with manufacturer's instructions.
B. Place composite panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
C. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.

3.05 FIELD QUALITY CONTROL

A. Owner will provide testing services in accordance with Section 01 4300 - Quality Assurance. Contractor shall provide temporary construction and materials for testing.
B. Upon completion of horizontal membrane installation, dam installation area in preparation for flood testing.
C. Flood to minimum depth of 1 inch with clean water, and after 48 hours inspect for leaks.
D. If leaking is found, remove water, repair leaking areas with new waterproofing materials as directed by Architect; repeat flood test, and repair damage to building.
E. When area is proven watertight, drain water and remove dam.

3.06 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.
B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION 07 1300

SECTION 07 1900

EXTERIOR WATER REPELLENTS AND GRAFFITI RESISTANT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Water Repellent and Sealer work as is indicated on the drawings and/or specified herein including, but not limited to, the following items.
B. Surfaces to be treated: Concrete tilt-up panels, concrete retaining walls, and exposed foundation walls.
   1. Water repellents.
   2. Anti-graffiti sealer.
   3. Combination water repellent and anti-graffiti sealer.
C. Surface preparation.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 4713 - Tilt-Up Concrete.
B. Section 09 9724 - Sealers - Interior Concrete, Precast and Masonry Sealers.
C. Section 31 1313 - Site Concrete: Exterior horizontal concrete surface sealer.

1.03 REFERENCE STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and Owner.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.
C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Manufacturer's Field Reports: Report whether manufacturer's best practices are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements for additional provisions.
   2. Extra Water Repellent Material: Two gallons of the each type installed.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with miminum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with minimum three years of documented experience

C. Owner reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

1.07 MOCK-UPS

A. Prepare representative surface 36 by 36 inches in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
   1. Conduct RILEM test on cured field sample. Allow product to fully cure 5 to 7 days before testing. Adjust application until required repellent performance is achieved.

B. Manufacturer's representative will review technical aspects; surface preparation, application, and workmanship.

C. Obtain Architect's written approval of field sample before start of material application, including approval of aesthetics, color, texture, and appearance.

D. Locate where directed.

E. Mock-up may remain as part of work.

1.08 FIELD CONDITIONS

A. Protect liquid materials from freezing.

B. Do not apply water repellent/sealers when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.

C. Do not apply water repellents/sealers when wind velocity is higher than 15 mph.

1.09 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store in unopened containers in a cool, dry area. Keep material from freezing in the container; do not store below 35 degrees F (2 degrees C) or above 100 degrees F (38 degrees C).

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer shall warrant respective products applied in accordance with manufacturer's specifications for a period of 5 years from date of Substantial Completion, against water intrusion due to material failure. When notified of such conditions, in writing, by the Owner, the manufacturer shall provide materials, and the applicator shall provide the labor to correct said deficiencies promptly and without inconvenience or cost to the Owner.

C. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Silane, Siloxane, Silane-Siloxane Blend, and Siliconate Water Repellents:
   1. BASF Construction Chemicals: www.buildingsystems.basf.com.
   2. Concrete Sealers USA: www.concretesealersusa.com.
   3. Dayton Superior Corporation: www.daytonsuperior.com.
   4. Evonik Corporation: www.evonik.com.
   5. Pecora Corporation: www.pecora.com.
   6. PROSOCO, Inc: www.prosoco.com.
   7. The QUIKRETE Companies: www.quikrete.com.
   8. Rust-Oleum Corporation; OKON S-20 Penetrating Silane-Siloxane Water Repellent Sealer: www.rustoleum.com.

9. Sherwin-Williams Company: www.sherwin-williams.com.
10. Rainguard International: www.rainguard.com.
11. L&M Construction Chemicals, Inc.: www.lmcc.com.
12. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Water Repellent and Graffiti-Resistant Sealer: Combination water repellent and graffiti-resistant sealer, colorless, non-yellowing, non-sacrificial, penetrating, water-vapor-permeable formulated to weatherproof concrete block and other porous masonry materials and protect treated surfaces from repeated graffiti attacks without altering the natural appearance.
   1. Acceptable Products:
      a. PROSOCO; Sure Klean Weather Seal Blok-Guard & Graffiti Control VOC9.
      b. Rainguard International; Micro-Seal with anti-graffitti.
      c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify joint sealants are installed and cured.
C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.02 PREPARATION

A. Protection of Adjacent Work:
   1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
   2. Protect adjacent surfaces not intended to receive sealer.
B. Prepare surfaces to be coated as recommended by manufacturer for best results.
C. Do not start work until masonry mortar and concrete substrate is cured a minimum of 60 days.
D. Remove loose particles and foreign matter.
E. Remove oil and foreign substances with a chemical solvent that will not affect sealer.
F. Scrub and rinse surfaces with water and let dry.
G. Allow surfaces to dry completely to degree recommended by sealer manufacturer before starting coating work.

3.03 APPLICATION

A. Apply in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
B. Apply at rate recommended by manufacturer, continuously over entire surface.
C. Remove sealer from unintended surfaces immediately by a method instructed by water repellent manufacturer.
D. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's best practices for preparation and application are being followed.

3.04 FINAL CLEANING

A. Clean site of all unused sealer, residues, rinse water, wastes, and effluents in accordance with environmental regulations.
B. Remove and dispose of all materials used to protect surrounding areas and non-masonry surfaces, following completion of the Work of this Section.

C. Repair, restore, or replace to the satisfaction of the Architect, all materials, landscaping, and non-masonry surfaces damaged by exposure to sealer.

SECTION 07 2100

THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete installation of all Building Insulation as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Rigid board insulation.
   1. XPS - Extruded Polystyrene.
C. Batt insulation.
D. Acoustical batt insulation.
E. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, exterior wall behind metal wall panels, and interior wall with facer providing exposed finish.
F. Mineral wool insulation.
G. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
H. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
I. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 04 2731 - Reinforced Unit Masonry: Masonry walls enclosing insulation.
B. Section 05 3100 - Steel Decking: Supporting construction for acoustical glass fiber board insulation.
C. Section 054000 - Cold-Formed Metal Framing: Supporting construction for batt and glass fiber board insulation.
D. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
E. Section 07 2129 - Sprayed Cellulose Acoustical Insulation: Sprayed-on, adhered fibrous insulation.
F. Section 07 4212: Composite Subframing Girt System.
G. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
H. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Samples: Provide two 6 inch by 6 inch (150 mm by 150 mm) samples of each type of insulation.
F. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
G. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org:
    1. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling and other sources. Store inside and in a dry location. Comply with manufacturer’s written instruction for handling, storing, and protecting during installation.
B. Protect foam-plastic board insulation as follows:
    1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
    2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
    3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.08 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation at Perimeter of Foundation: Extruded polystyrene board.
B. Insulation Inside Prefabricated Wall Panels: Extruded polystyrene (XPS) board.
C. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
D. Insulation at Interior Roof Deck in Auditorium: Acoustical glass fiber board.

E. Insulation in Interior Metal Framed Walls: Acoustical batt insulation.
F. Insulation Above Lay-In Acoustical Ceilings and Ceiling Clouds: Acoustical batt insulation.
G. Insulation at Exterior Soffits: Batt insulation.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
   1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value: Type IV, 5.6 (0.98), minimum, per 1 inch thickness at 75 degrees F mean temperature.
   5. Board Size: 48 inch by 96 inch.
   6. Board Thickness: 2-3/16 inch.
   7. Board Edges: Shiplap, at long edges.
   8. Products:
      a. DuPont de Nemours, Inc; Styrofoam Brand Ultra SL (Shiplap): building.dupont.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.
B. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Complies with ASTM C578, and manufactured using carbon black technology.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Type and Thermal Resistance, R-value: Type IV, 5.6 (0.98), minimum, per 1 inch thickness at 75 degrees F mean temperature.
   4. Board Size: 15-3/4 inch by 96 inch.
   5. Board Thickness: 2-3/16 inch.
   6. Board Edges: Square.
   7. Products:
      a. DuPont de Nemours, Inc; Styrofoam Brand Cavitymate Ultra: building.dupont.com.

2.03 BATT INSULATION MATERIALS

A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
   3. Formaldehyde Content: Zero.
   4. Thermal Resistance: R of 13/19.
   5. Thickness: 3 1/2 inch, 6 inch (150 mm).
   6. Manufacturers:
      a. Owens Corning Corp: www.ocbuildingspec.com
      b. CertainTeed Corporation: www.certainteed.com.
      c. Johns Manville: www.jm.com.
      d. Knauf Insulation: www.knaufinsulation.us.
      e. Substitutions: See Section 01 6000 - Product Requirements.
C. Acoustical Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 10 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 10 or less, when tested in accordance with ASTM E84.
   3. Formaldehyde Content: Zero.

4. NRC Value: 1.00.
5. Thickness: 3 1/2 inch.
6. Facing: Unfaced.
7. Manufacturers:
    a. CertainTeed Corporation: www.certainteed.com.
    b. Johns Manville Corporation: www.jm.com.
    c. Owens Corning Corp: www.ocbuildingspec.com
    d. Knauf Insulation: www.knaufinsulation.us.
    e. Substitutions: See Section 01 6000 - Product Requirements.

D. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
2. Manufacturers:
    a. Johns Manville; MinWool Sound Attenuation Fire Batts:
    b. ROCKWOOL (ROXUL, Inc); COMFORTBATT:
    c. ROCKWOOL (ROXUL, Inc); AFB™:
    d. Thermafiber, Inc; SAFB FF:
    e. Substitutions: See Section 01 6000 - Product Requirements.

2.04 MINERAL WOOL INSULATION MATERIALS

A. Exterior Curtain Wall Insulation: Semi-rigid preformed mineral wool insulation complying with ASTM C612.
1. Thickness as noted in tested and listed assembly.
2. Density:
    a. 8.0 pcf (nominal)
3. R-value: 4.2 per inch.
4. Facing:
    a. Unfaced
5. Flame Spread Index: 0 when tested in accordance with ASTM E84.
6. Smoke Developed Index: 0, when tested in accordance with ASTM E84.
7. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
8. Recycled content: minimum 70 percent.
9. Manufacturers:
    a. Owens Corning Thermafiber FireSpan 40: www.ocbuildingspec.com.
    b. Johns Manville: www.jm.com.
    c. Roxul: www.roxul.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

B. Rain Screen/Continuous Insulation: Semi-rigid mineral wool insulation board that is water repellent and complies with ASTM C612.
1. Thickness as noted in tested and listed assembly or per drawings.
2. Density: 6.0 pcf (nominal).
3. R-value: 4.2 per inch.
4. Facing: Unfaced.
5. Flame Spread Index: 0, when tested in accordance with ASTM E84.
6. Smoke Developed Index: 0, when tested in accordance with ASTM E84.
7. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
8. Moisture Resistance: Absorbs less than 0.03 percent by volume, ASTM C1104.
9. Recycled content: minimum 70 percent.
10. Manufacturers:
    a. Owens Corning RainBarrier HD: www.ocbuildingspec.com.

b. Johns Manville: www.jm.com.
c. Roxul: www.roxul.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORIES

A. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
B. Insulation Fasteners: Lengths of galvanized13 gauge (0.072 inch) high carbon spring steel with chisel or mitered tips, held in place by tension, length to suit insulation thickness and substrate, capable of securely supporting insulation in place.
C. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
D. Fasteners: Type recommended by insulation manufacturer for application.
E. Adhesive: Type recommended by insulation manufacturer for application.
F. Joint Closure Strips: Type recommended by insulation manufacturer for application.
G. Joint Tape: Type recommended by insulation manufacturer for application.
H. Sealant: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.
C. Do not begin installation until substrates have been properly prepared.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Install boards horizontally on foundation perimeter.
    1. Install in running bond pattern.
    2. Butt edges and ends tightly to adjacent boards and to protrusions.
B. Extend boards over expansion joints, unbonded to foundation on one side of joint.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.
    1. Install in running bond pattern.
    2. Butt edges and ends tightly to adjacent boards and protrusions.
B. Extend boards over expansion joints, unbonded to wall on one side of joint.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
D. Tape insulation board joints.

3.04 BOARD INSTALLATION AT CAVITY WALLS

A. Install boards to fit snugly between wall ties.
B. Install boards horizontally on walls.
    1. Install in running bond pattern.
    2. Butt edges and ends tightly to adjacent boards and protrusions.
C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.05 BOARD INSTALLATION AT ROOF DECK

A. Install board insulation in accordance with manufacturer’s installation guidelines.
B. Install boards with long axis perpendicular to supports. Ensure end joints are fully supported.
C. Cut and fit boards to suit project requirements.

3.06 BATT INSTALLATION

A. Install insulation and vapor retarder if required, in accordance with manufacturer's instructions.
B. Install in exterior soffit spaces without gaps or voids. Do not compress insulation.
C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
D. Fit insulation tightly in cavities. Split insulation to fit snug around mechanical and electrical services within the plane of the insulation.
E. Tape or staple insulation batt flanges to framing members.
F. Retain unfaced insulation batts in place with wire mesh secured to framing members.
    1. Use in walls where wall board is installed on one side only
G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
H. Loose-lay insulation on top of acoustical ceiling tiles and between suspension system members. Ensure insulation is in direct contact with ceiling tiles without voids or gaps.

3.07 FIELD QUALITY CONTROL

A. See Section 01 4300 - Quality Assurance for additional requirements.
B. Jointly with Architect and manufacturer’s representative, visually inspect the rigid foam insulation system application and confirm that the installation is in strict accordance with the manufacturer's recommendations.
C. Ensure exposed or visible applications meet the manufacturer’s standards for uniform appearance.
D. Correct identified defects and irregularities.

3.08 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

SECTION 07 2119

FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Foamed-In-Place Insulation work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Foamed-in-place insulation:
   1. In exterior framed walls.
   2. In exterior wall crevices.
   3. At junctions of dissimilar wall and roof materials.
C. Ignition barrier or thermal barrier protective coating where required.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Fabrications.
B. Section 07 2100 - Building Insulation.
C. Section 07 2500 - Weather Barriers.
D. Section 09 2116 - Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2021.
E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
G. ICC-ES AC377 - ICC-ES Acceptance Criteria for Spray-applied Foam Plastic Insulation; 2011.
H. ICC-ES-ESR 3702 - ICC-ES Evaluation Report DC 315 Coating; 2017.
I. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements, along with applicable ICC-ES reports.
C. Certificates: Certify that products of this section meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
E. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
B. Applicator Qualifications: Company specializing in performing work of the type specified,with minimum five years of documented experience and approved by manufacturer.

1.07 MOCK-UPS

A. Construct one mock-up, 8 feet long by 8 feet wide; include insulation overcoat and wall construction in mock-up.
B. Locate where directed.
C. Mock-up may remain as part of work.

1.08 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
B. Do not apply foam when temperature is within 5 degrees F of dew point.

1.09 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Icynene-Lapolla; Icynene ProSeal (MD-C-200 v3): www.icynene.com.
B. Other Approved Manufacturers:
   1. SWD Quick Shield 112: www.swdurethane.com.
   2. Dow Chemical Company: www.dow.com.
   3. BASF Polyurethane Foam Enterprises LLC; Spraytite: www.basf.us.
   4. Demilec LLC; DEMILEC APX: www.demilec.com.
   5. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com.
   6. NCFI Polyurethanes: www.ncfi.com.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Aged Thermal Resistance: R-value (RSI-value) of 6.4 (degrees F hr sq ft)/Btu minimum, when tested at 1 inch (25.4 mm) thickness in accordance with ASTM C518 after aging for 180 days at 41 degrees F (23 degrees C).
   2. Thickness of applied product: As shown on drawings.
   3. Water Vapor Permeance: Vapor retarder; less than 1 perm, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, dessicant method.

4. Water Vapor Permeance: Vapor retarder; less than .97 perm, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, dessicant method.
5. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
6. Air Permeance: Less than 0.004 cfm/sq ft, (for 1.5 inches of material) maximum, when tested in accordance with ASTM E283 at 1.5 psf.
7. Closed Cell Content: At least 90 percent.
8. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.03 ACCESSORIES

A. Primer: As required by insulation manufacturer.
B. Ignition Barrier Protective Coating: Protective coating complying with the requirements of ICC (IBC) Section 803.1.2 and Section 2603.9 under "Special Approval for Thermal Barriers Over Foam" and NFPA 286 Ignition Barrier per ICC-ES AC377 Appendix X.
   1. Product as recommended by Insulation Manufacturer or:
   2. International Fireproof Technology Inc. DC-315: water-based, intumescent paint, conforming to the following:
      a. Full scale fire resistance test with Icynene ProSeal (MD-C-200v3) in accordance with NFPA 286: 24 wet mils (thermal barrier).
      b. Compatible with MD-C-200 according to ICC-ES-ESR 3702.
      c. Finish: Flat, grey color.
      d. VOC Content: 47 g/L.
      e. Volume Solids: 67 percent.
      f. Flash Point: None.
      g. Mechanism of cure: Coalescence.
      h. Reducer/cleaner: Water.
      i. Collaborative for High Performance Schools (CHPS) Low-emitting material per CA Section 01350 criteria.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.
B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.
B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by spray method, to a uniform monolithic density without voids.
C. Apply to a minimum cured thickness as shown on drawings.
D. Apply overcoat to a uniform minimum thickness as needed to achieve fire rating required.
E. Patch damaged areas.
F. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
G. Trim excess away for applied trim or remove as required for continuous sealant bead.

H. Apply ignition barrier/thermal barrier protective coating in accordance with manufacturer's instructions.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4300 - Quality Assurance for additional requirements.
B. Field inspections and tests will be performed by an independent testing agency.
C. Inspection will include verification of insulation thickness and density.

3.05 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION 07 2119

SECTION 07 2500

WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Weather Barriers work as in indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Water-Resistive Barriers.
   1. Water-resistive barrier coating, fluid applied.
   2. Water-resistive barrier for metal composite wall panels.
C. Accessories.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Water-resistive barrier under exterior cladding.
B. Section 07 4264 - Metal Composite Wall Panels.
C. Section 07 4616 - Aluminum Soffits.
D. Section 07 5400 - Thermoplastic Membrane Roofing.
E. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.03 DEFINITIONS

A. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

1.04 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
B. ASTM D751 - Standard Test Methods for Coated Fabrics; 2019.
C. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
E. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2021.
H. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; 2015.
I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on material characteristics.
C. Shop Drawings: Provide drawings of special joint conditions.
D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 MOCK-UPS

A. See Section 01 4300 - Quality Assurance for additional requirements.
B. Construct typical exterior wall panel, 6 foot long by 6 foot wide incorporating the sheathing board or substrate, sill pan protection system, window frame and attachment method, clips, strapping or masonry ties, attachment of insulation and detailing of Weather Barrier membrane application and lap seams.
C. Locate where directed.
D. Mock-up may remain as part of work.

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer’s standard material warranty in which manufacturer agrees to provide replacement material for the weather barrier installed in accordance with manufacturer's instructions that fails due to material defects within 20 years of the date of Substantial Completion.

PART 2 PRODUCTS

2.01 WATER-RESISTIVE BARRIER MATERIALS

A. Water-Resistive Barrier: For use in Construction Types I, II, III, and IV on buildings greater than 40 feet in height.
    1. Comply with NFPA 285 wall assembly requirements in accordance with local building code and authorities having jurisdiction (AHJ).
B. Water-Resistive Barrier Coating: Fluid applied, UV-resistant coating for use over various types of exterior sheathing, CMU, and precast concrete in accordance with ICC-ES AC212.
    1. Dry Film Thickness (DFT): 15 mils, .38 mm, minimum.
    2. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure B - Water Method.
    3. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 120 days of weather exposure.
    4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A when tested in accordance with ASTM E84.
    5. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
    6. Joint Preparation Treatment: As recommended by coating manufacturer.
    7. Self-healing if penetrated.
    8. Products:
        a. Momentive Performance Materials, Inc/GE Silicones; _____: www.siliconeforbuilding.com.
        b. PROSOCO, Inc; _____: www.prosoco.com.

c. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES

A. Sealants, Tapes, and Accessories Used for Sealing Water-Resistive Barrier and Adjacent Substrates: As indicated or complying with water-resistive barrier manufacturer's installation instructions.

B. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and weather barrier materials.
   1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch nominal thickness.
   2. Color: Green.
   3. Elongation: 1,300 percent, measured in accordance with ASTM D412.
   4. Peel Adhesion: 28 lb/inch, minimum, when tested in accordance with ASTM D903.
   5. Hydrostatic Head Pressure: Resist head pressure of 57 feet, maximum, when tested in accordance with ASTM D751.
   6. Products:
      a. Rubber Polymer Company; Rub-R-Wall Mastic: www.rpcinfo.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. Primer: Liquid applied polymer.
   1. Color: Green.
   2. Elongation: 1,300 percent, measured in accordance with ASTM D412.
   3. Products:
      a. Rubber Polymer Company; Rub-R-Wall Aqua Mastic: www.rpcinfo.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

D. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
   1. Width: 4 inches.
   2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
   3. Products:
      a. Henry Company; FortiFlash: www.henry.com.
      b. Henry Company; FortiFlex Butyl: www.henry.com.
      c. Henry Company; FortiFlash Butyl: www.henry.com.

E. Liquid Flashing: One part, fast curing, nonsag, elastomeric, gun grade, trowelable liquid flashing.
   1. Products:
      a. Dow; DOWSIL 778 Silicone Liquid Flashing: www.dow.com.
      b. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com.
      c. Master Builders Solutions; MasterSeal AWB 900: www.master-builders-solutions.com/en-us.
      d. Master Wall Inc; SuperiorFlash: www.masterwall.com.
      e. Momentive Performance Materials, Inc/GE Silicones; Elemax 5000 Liquid-Applied Flashing: www.siliconeforbuilding.com.
      f. Parex USA, Inc; WeatherTECH with WeatherFlash: www.parexusa.com.
      g. Pecora Corporation; _____: www.pecora.com.
      h. Polyglass USA, Inc; PolyFlash 1C - One Part Flashing Compound: www.polyglass.us.

F. Stainless Steel Flashing: Flexible flashing with 2 mil, 0.002 inch thick Type 304 stainless steel sheet, 8 mil, 0.008 inch of butyl adhesive and siliconized release liner.
   1. Roll Length: 50 feet long.
   2. Width: 4 inches wide.
   3. Products:

a. Momentive Performance Materials, Inc/GE Silicones; GE Elemax SS Flashing: www.siliconeforbuilding.com.
b. Substitutions: See Section 01 6000 - Product Requirements.

G. Thinners and Cleaners: As recommended by water-resistive barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions comply with requirements of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's installation instructions.
B. Water-Resistive Barriers: Install continuous water-resistive barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
C. Mechanically Fastened Exterior Sheets:
1. Install sheets shingle-fashion to shed water, with seams aligned horizontal.
2. Overlap seams as recommended by manufacturer, 6 inches, minimum.
3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches, minimum.
4. Install water-resistive barrier over jamb flashings.
5. Install head flashings under water-resistive barrier.
6. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.

D. Self-Adhered Sheets:
1. Prepare substrate in accordance with sheet manufacturer's installation instructions; fill and tape joints in substrate and between dissimilar materials.
2. Lap sheets shingle-fashion to shed water and seal laps airtight.
3. Upon placement of sheets, firmly press onto substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.
4. Use same material, or other material approved by sheet manufacturer, to seal sheets to adjacent substrates, and as flashing.
5. At expansion joints, provide transition to joint assemblies approved by sheet manufacturer.

E. Coatings:
1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
2. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.

F. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches onto water-resistive barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.

3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches beyond face of jambs; seal water-resistive barrier to flashing.
5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.04 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION 07 2500

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SECTION 07 4264

METAL COMPOSITE WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services to fully complete all Metal Composite Wall and Soffit Panel work as is indicated on the drawings or specified herein including, but not limited to, the following described items.
B. Aluminum composite rainscreen system consisting of formed metal composite material (ACM) sheet, secondary supports, and anchors to structure, attached to solid backup.
C. Matching flashing, and trim.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Panel support framing.
B. Section 07 2500 - Weather Barriers: Weather barrier behind wall panel system.
C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.
D. Section 07 9200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

A. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014 (Reapproved 2020).
B. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).
C. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).
D. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2020.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
F. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2021.
G. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
H. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2019.
J. SAE J429 - Mechanical and Material Requirements for Externally Threaded Fasteners; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, co-ordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
    1. Require attendance by the installer and relevant sub-contractors.

2. Include ACM sheet manufacturer's representative and wall system manufacturer's representative to review storage and handling procedures.
3. Review in detail truck transportation, parking, vertical transportation, schedule, personnel, installation of adjacent materials and substrate.
4. Review procedures for protection of work and other construction.
5. Review safety precautions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data - ACM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.
C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.
   4. Specimen warranty for wall system, as specified herein.
D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, exposed fasteners, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Indicate panel numbering system.
   2. Differentiate between shop and field fabrication.
   3. Indicate substrates and adjacent work with which the wall system must be coordinated.
   4. Include large-scale details of anchorages and connecting elements.
   5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than 1-1/2 inches per 12 inches.
   6. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
E. Selection Samples: For each finish product specified, submit at least three sample color chips representing manufacturer's standard range of available colors and patterns.
   1. Sealant Color: Color as selected by Architect.
F. Verification Samples: For each finish product specified, submit at least three samples, minimum size 12 inch square, and representing actual product in color and texture.
G. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
H. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Testing Agency's Qualification Statement.
L. Maintenance Data: Care of finishes and warranty requirements.
M. Executed Warranty: Submit warranty and ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
C. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.
    1. With not less than three years of documented experience.
    2. Approved by ACM sheet manufacturer.
    3. Submit contact names and phone numbers for at least three references connected with successful past projects.
D. Installer Qualifications: Company specializing in performing work of the type specified in this section.
    1. With minimum 10 years of documented experience.
    2. Approved by wall panel system manufacturer.
    3. Submit contact names and phone numbers for at least three references connected with successful past projects.
E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.
F. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
    1. Locate where directed.
    2. Provide panels finished as specified.
    3. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
    1. Protect finishes by applying heavy duty removable plastic film during production.
    2. Package for protection against transportation damage.
    3. Provide markings to identify components consistently with drawings.
    4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
    1. Store in well ventilated space out of direct sunlight.
    2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
    3. Store at a slope to ensure positive drainage of any accumulated water.
    4. Do not store in any enclosed space where ambient temperature can exceed 120 degrees F.
    5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.08 WARRANTY / GUARANTEE

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.
C. Wall System Warranty: Provide written warranty by manufacturer agreeing to correct defects in manufacturing within a 5 year period after Date of Substantial Completion.
D. ACM Sheet Manufacturer’s Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years:
    1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.

2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material (MCM) Sheet Manufacturers:
   1. 3A Composites USA; Alucobond: www.alucobondusa.com.
   2. ALPOLIC Materials: www.alpolic-americas.com.
   3. Reynobond : www.arconic.com.
   4. Western Building Group; Alfrex. www.westernbuildinggroup.com.

B. Wall Panel System:
   1. Basis of Design Manufacturer:
      a. System: PER - Pressure Equalized Rainscreen dry joint rainscreen system.

C. Thermal Broken Rainscreen Attachment
   1. Basis of Design Manufacturer:
      a. Knight Wall Systems
         1) Horizontal HCI Girt, spacing as required for rainscreen system.

D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WALL PANEL SYSTEM

A. Metal panels, fasteners, and anchors designed to be supported by framing or other substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
   1. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
   2. Provide panel jointing with dry joint.
   3. Anchor panels to supporting framing without exposed fasteners.

B. Panels: 2 inch maximum deep pans formed of metal composite material sheet by routing back edges of sheet, folding edges and attaching to aluminum perimeter extrusions with ventilation slots.
   1. Exposed edges to be protected by aluminum extrusion.
   2. Wrap panel over extrusion and attach with rivets painted to match panel color. Extrusions to be painted to match panel color if exposed.
   3. Reveals at Panel: Joint size between the faces of the perimeter extrusions shall be 5/8 inch (15.88 mm) nominal.
   4. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
      a. Stiffeners: Extruded aluminum sections secured to edge trim and bonded to rear face of panel with silicone.
   5. Metallic Finished Panels: Maintain consistent grain of ACM sheet; specifically, do not rotate sheet purely to avoid waste.
   6. Fabricate panels under controlled shop conditions. Field fabrication prohibited, unless approved by Architect.
   7. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
   8. Fabricate as indicated on drawings and as recommended by ACM sheet manufacturer.

a. Make panel lines, breaks, curves and angles sharp and true.
b. Keep plane surfaces free from warp or buckle.
c. Keep panel surfaces free of scratches or marks caused during fabrication. Contractor to approve areas of completion by ACM subcontractor and protect areas thereafter.
d. Contractor to approve areas of completion by ACM subcontractor and protect areas thereafter.

9. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

2.03 MATERIALS

A. Metal Composite Material (ACM) Sheet: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials; core material free of voids and spaces; no foamed insulation material content.
1. Overall Sheet Thickness: 4 mm, minimum.
2. Alloy: AA3000 Series aluminum sheet.
3. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
4. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
5. Factory Finish: Three coat fluoropolymer resin coating, approved by the coating manufacturer for the length of warranty specified for the project, and applied by coil manufacturing facility that specializes in coil applied finishes.
6. Color to be approved by Architect by from manufacturer's full line, including specialty colors:
a. Basis of Design:
1) Color 1: Alfrex Copper Penny Mica (JY-2570).
2) Color 2: Alfrex Champagne Mica (JY-2550).

B. Aluminum Extrusions:
1. Perimeter Extrusions:
a. Alloy: AA-6063-T6.
b. Finish: Same finish as ACM sheets, color to match.
2. Stiffeners:
a. Alloy: AA-6063-T6.
b. Finish: Mill finish.

2.04 FABRICATION

A. Fabricate panel units to dimensions indicated on the guaranteed dimension shop drawings based on an assumed design temperature of +70 degrees F. Allow for ambient temperature range at time of fabrication and erection.

B. Fabricate panels in sizes shown using ACM and perimeter extrusion so that the panel thickness at the joinery is no more than 1.75". Completed panel shall be properly fabricated and designed so that no restraints are placed on the panel, which might result in excessive compressive skin stresses. The installation detailing shall be such that the installed panels shall remain flat due to temperature changes and at all times remain water and air-tight. Oil canning of panel surface is not acceptable.

C. Where practical, shop fabricate units ready for erection. If not shop assembled, pre-fabricate components at the shop as required for proper and expeditious field assembly.

D. Design, fabricate, assemble, and erect wall panel units, to insure a weather tight system, as required in this specification section.
E. Where drawings indicate, factory curve panels to required radii. Extrusions shall be factory stretched formed to conform to panel curve.
F. Provide stiffeners secured to rear face of panels mechanically fastened to edge trim members, with spacing as required by specific job wind loading.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.
B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.
C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect adjacent work areas and finish surfaces from damage during installation.

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
B. Comply with instructions and recommendations of ACM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with ACM sheet manufacturer's instructions and recommendations for field forming.
F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals. Apply a coat of bituminous paint, concealed, on one or both surfaces wherever dissimilar metals would be in contact.
G. Where joints are designed for field applied sealant, seal joints completely with specified sealant.
H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
    1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
    2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
    3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
    4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.
I. Replace damaged products.
    1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by Architect, panel manufacturer, and fabricator.

2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet under all typical light conditions experienced at the project.

3.04 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
C. Remove temporary coverings and protection of adjacent work areas.
D. Clean installed products in accordance with manufacturer's instructions.

3.05 PROTECTION

A. General Contractor to protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION 07 4264

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SECTION 07 4616

ALUMINUM SOFFIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Aluminum Siding work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Aluminum Soffits - Wood Grained
C. Trim, flashings, accessories, and fasteners for aluminum siding.

1.02 RELATED REQUIREMENTS

A. Section 07 2500 - Weather Barriers.
B. Section 07 4264 - Metal Composite Wall Panels.
C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings and trim associated with metal siding.
D. Section 07 9200 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.03 REFERENCE STANDARDS

A. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2021.
B. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
    1. Preparation instructions and recommendations.
    2. Siding materials, underlayment, flashings, fasteners and accessories.
    3. Dimensions, physical properties, and typical details.
    4. Storage and handling requirements and recommendations.
    5. Installation instructions and recommendations.
C. Shop Drawings: Indicate layout, methods of attachment, provisions for movement, flashing, trim, edge and field conditions, interface with adjacent materials, locations of cutouts or special shapes, existing construction, and details.
D. Samples: For each finish product specified, provide two complete sets of color chips representing manufacturer's full range of available colors and patterns, including the following:
    1. Siding: Two of each type; full panel width by 12 inches long.
    2. Fasteners and Accessories: Two of each type; full size, and indicate use.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.
C. Powder-coating Manufacturer Qualifications: Minimum five years of experience producing aluminum finishes of the types specified in AAMA 2605 and 2605

1.06 MOCK-UP

A. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and gloss are approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing brand name and manufacturer's identification until ready for installation.
B. Verify quantities and condition immediately upon receipt; remove damaged materials from site, and coordinate with manufacturer to replace with new materials meeting specified requirements.
C. Store products off the ground, within manufacturer's temperature and environmental limits, away from moisture, protected from traffic and construction activities, and minimize on-site storage prior to installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Manufacturer's Warranty: Provide manufacturer's standard lifetime, non-prorated, transferable warranty, including 50 year hail protection warranty.
C. Manufacturer's warranty on siding and trim accessories finishes to cover the following:
   1. Color fading of not more than five Hunter color-difference units when tested in accordance with ASTM D2244.
   2. Degree of chalking of eight or greater when tested in accordance with ASTM D4214.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum Soffits
   1. Basis of Design: RMP Metal Products: rollfabmetal.com
   2. Other Manufacturers
      a. Gentek Building Products, Inc: www.gentekinc.com
      b. Kaycan Ltd: www.kaycan.com
      c. Knotwood, a brand of OmniMax International: www.knotwood.com/
      d. Ply Gem: www.plygem.com/

2.02 MATERIALS

A. Extruded Aluminum (6063-T6 Alloy) Siding and Soffits: Alumaboard Wood Grain Finish Aluminum Siding and Soffits is extruded aluminum with integrated venting.
B. Sizes:
   1. 6” Alumaboard V Groove Plank (ALB6PL)
   2. Note: Clips included
C. Accessories: Prefinished aluminum: Provide with matching accessories and starter strips as required.

D. J Outside Corner (ALB OSC)
Inside Corner (ALB ISC)
J Closure End Cap (ALBJCL)
Snap Cap End Top (ALBSCET)
Snap Cap End Base (ALBSCEB)
Snap Cap Flat (ALBSCF)
Snap Cap Reveal (ALBSCR)
Snap Cap Base (ALBSCB)
Starter (ALBSTR)

E. Accessories: Stainless Steel…with less than 14% Chromium content, 304-2b (1/4 Hard), 0.035" Thick

2.03 FINISHES

A. Pretreatment: Chrome Free five stage aluminum pretreatment system. Complies with AAMA 2603 AAMA 2604 and AAMA 2605 Superior Performance Standard and meets EPA, OSHA, State and Local environmental requirements and contains no chromates, cyanides or other heavy metals. Waste treatment is usually a simple pH neutralization and disposal to the sanitary sewer.

B. Extremely Durable Powder Coatings: Premium Wood Finishes use a polyurethane powder coat with ink based wood grain patterns sublimated into the base powder effectively tattooing the powder. The combined effect creates all the aesthetic aspects of real wood while offering the same environmental advantages of powder coated finishes.
   1. Wood Grained – Contact Rollfab Metal Products for available color and texture finishes

2.04 FABRICATION

A. Prepare surfaces, pre-treat and coat components in accordance with AAMA 2604 and 2605 Quality Standards and applicable European standards for the coating material specified.

B. Wrap and package coated components using methods suitable for transit and covered site storage without damage.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate conditions before beginning installation.
B. Verify dimensions and acceptable substrate condition.
C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
D. Do not proceed with installation until unacceptable conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Prepare surfaces as recommended by manufacturer.

3.03 INSTALLATION

A. Install aluminum soffit, trim, and accessories in accordance with manufacturer's written instructions.
B. Attach using manufacturers recommended fasteners, sealants, and adhesives, allowing for thermal expansion.
C. Provide concealed fasteners except where approved on shop drawings.
D. Install joint sealants as specified in Section 07 9200 for a watertight installation.
E. Where dissimilar materials are in contact, prevent galvanic action as recommended by manufacturer.

3.04 CLEANING

A. Remove grease and oil films, excess joint sealer, handling marks, and other installation debris from aluminum siding, leaving siding clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to material finishes.

3.05 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 4616

SECTION 07 5419

SINGLE-PLY PVC THERMOPLASTIC ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mechanically attached PVC thermoplastic roofing membrane.
B. Insulation, flat and tapered.
C. Vapor retarder.
D. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 07 6200 - Sheet Metal Flashing and Trim: Counterflashings, reglets and .

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.
C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
D. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2022.
E. ASTM D4434/D4434M - Standard Specification for Poly(Vinyl Chloride) Sheet Roofing; 2021.
F. FM DS 1-28 - Wind Design; 2016.
G. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2016.
H. NRCA (RM) - The NRCA Roofing Manual; 2022.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide manufacturer's written information listed below.
    1. Product data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Warranty:
    1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
    2. Submit installer's certification that installation complies with all warranty conditions for the waterproof membrane.
F. Installer's qualification statement.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
B. Protect products in weather protected environment, clear of ground and moisture.
C. Protect foam insulation from direct exposure to sunlight.

1.06 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees Fahrenheit or above
   1. degrees F.
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
   1. Warranty Term: 30 years.
   2. For repair and replacement include costs of both material and labor in warranty.
   3. Exceptions NOT Permitted:
      a. Damage due to wind of speed greater than 56 mph but less than 90 mph.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Carlisle SynTec: www.carlisle-syntec.com.
B. Sika Sarnifil.
C. Substitutions: Not permitted.

2.02 ROOFING APPLICATIONS

A. PVC Membrane Roofing: One ply membrane, mechanically fastened, over insulation.
B. Roofing Assembly Performance Requirements and Design Criteria:
   1. Wind Uplift:
      a. Designed to withstand wind uplift forces calculated with ASCE 7.
      b. Design Wind Speed: In accordance with local building code and authorities having jurisdiction (AHJ).

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane:
   1. Material: Polyvinyl chloride (PVC) complying with ASTM D4434/D4434M.
   2. Reinforcing: Internal fabric.
   3. Thickness: 60 mils (0.060 inch), minimum.
   4. Sheet Width: Factory fabricated into largest sheets possible.
   5. Color: White.
   6. Products:
      a. Carlisle SynTec Systems; SureFlex PVC.
B. Seaming Materials: As recommended by membrane manufacturer.
C. Membrane Fasteners: As recommended and approved by membrane manufacturer.
   1. Carlisle SynTec Systems; HP-X Fastener: #15 threaded fastener with #3 Phillips drive. Use with Carlisle SynTec Systems Piranha Fastening Plate for mechanically fastened membrane systems on steel or plywood decks.
D. Flexible Flashing Material: Same material as membrane.

2.04 DECK SHEATHING AND COVER BOARDS

A. Cover Board: Polyisocyanurate (ISO) thermal board, complying with ASTM C1289; Type II - Faced with dark coated-glass facer on one side and light coated-glass facer on other surface of core foam, Class 4 with thickness of 1/2 inch, and Grade 1 with 109 psi, maximum, compressive strength.
   1. Product: Carlisle SecurShield HD Polyiso.

2.05 INSULATION

A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578, and with drainage channels on one face.
   1. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
   2. Type and Compressive Resistance: Type XI, 5 psi, minimum.
B. Composite Polyisocyanurate (ISO) Board Insulation: Composite insulation panel comprised of 1/2 inch thick high-density ISO cover board laminated to ISO base insulation, complying with ASTM C1289.
   1. Base Insulation: Type II, Class 2, Grade 2, with 20 psi, minimum, compressive strength.
   2. Cover Board: Type II, Class 4, Grade 1, with 109 psi, maximum, compressive strength.
   3. Product: Carlisle SecurShield HD Composite.

2.06 ACCESSORIES

A. Prefabricated Flashing Accessories:
   1. Corners and Seams: Same material as membrane, in manufacturer's standard thicknesses.
   2. Penetrations: Same material as membrane, with manufacturer's standard cut-outs, rigid inserts, clamping rings, and flanges.
   3. Walkway Rolls: Sure-Flex Heat Weldable Walkway Rolls; 80 mils (0.080 inch) thick; gray membrane.
   4. Contour Rib Profile: Manufacturer's standard extruded PVC; 1-1/4 inch tall, 2-1/8 inch wide, 3/8 inch profile.
   5. Miscellaneous Flashing: Non-reinforced PVC membrane; 80 mils (0.080 inch) thick, in manufacturer's standard lengths and widths.
B. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
C. Membrane Adhesive: As recommended by membrane manufacturer.
   1. Products:
D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
E. Sealants: As recommended by membrane manufacturer.
   1. Products:
F. Cleaner: Manufacturer's standard, clear, solvent-based cleaner.
G. Edgings and Terminations: Manufacturer's standard edge and termination accessories.
   1. Snap-On Edge System:
   2. Anchor Bar Fascia System:
   3. Drip Edge:
   4. Coping:
   5. PVC Coated Sheet Metal.
   6. Termination Bar.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.03 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.04 INSULATION INSTALLATION

A. Attachment of Insulation:
    1. Mechanically fasten insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
B. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
C. Lay boards with edges in moderate contact without forcing, and gap between boards no greater than 1/4 inch. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
D. Do not apply more insulation than can be completely waterproofed in the same day.

3.05 MEMBRANE APPLICATION

A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
B. Shingle joints on sloped substrate in direction of drainage.
C. Seam Welding:
    1. Seam Welding: Overlap edges and ends and seal seams by heat welding, minimum 2 inches.
    2. Cover all seams with manufacturer's recommended joint covers.

3. Probe all seams once welds have thoroughly cooled. (Approximately 30 minutes.)
4. Repair all deficient seams within the same day.
5. Seal cut edges of reinforced membrane after seam probe is complete.

D. Mechanical Attachment:
1. Apply membrane and mechanical attachment devices in accordance with manufacturer's instructions.

E. At intersections with vertical surfaces:
1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
2. Fully adhere flexible flashing over membrane and up to nailing strips.

F. Coordinate installation of roof drains and sumps and related flashings.

G. Daily Seal: Install daily seal per manufacturers instructions at the end of each work day. Prevent infiltration of water at incomplete flashings, terminations, and at unfinished membrane edges.

3.06 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for general requirements for field quality control and inspection.

B. Require site attendance of roofing and insulation material manufacturers daily during installation of the Work.

3.07 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 5419

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SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Sheet Metal Flashing and Trim work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Fabricated sheet metal items, including copings, drip edges, flashings, counterflashings, gutters, downspouts, sheet metal roofing, and other items shown on Drawings.
C. Sealants for joints within sheet metal fabrications.
D. Reglets and accessories.
E. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 4713 - Tilt-Up Concrete.
B. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.
C. Section 07 7123 - Manufactured Gutters and Downspouts.
D. Section 07 5300 - Elastomeric Membrane Roofing: Flashings associated with roofing system.
E. Section 07 5400 - PVC Membrane Rino Bond: Flashing associated with roofing system.
F. Section 07 7200 - Roof Hatches and Accessories: Manufactured metal roof curbs.
G. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
H. Division 23 - HVAC: Flashing sleeves and collars for mechanical items protruding through roofing membrane.
I. Division 26 - Electrical: Flashing sleeves and collars for electrical items protruding through roofing membrane.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2020.
B. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates; 2002.
C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2020a.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
F. CDA A4050 - Copper in Architecture - Handbook; current edition.
G. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
C. Samples: Submit two samples 12 inches by 12 inches in size illustrating metal finish color.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
B. Maintain one copy of each document on site.
C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Finish Warranty: On steel manufacturer’s standard form, in which manufacturer agrees to repair or replace fabricated items that evidence deterioration of finish within 20 years from date of Substantial Completion.
C. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sheet Metal Flashing and Trim Manufacturers:
    1. Drexel Metals: www.drexelmetals.com
    2. Ryerson Building Products; ColorKlad: www.ryerson.com.
    3. Peterson Aluminum Corporation; Pac-Clad: www.pac-clad.com.
    4. Firestone Metal Products; Una-Clad: www.firestonemetal.com.
    5. York Manufacturing, Inc; York: www.yorkmfg.com
    6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, 0.028 inch thick base metal, shop pre-coated with PVDF coating.
    1. Finish Side: PVDF (Polyvinylidene Fluoride) Coating: High Performance Organic Finish, AAMA 621, AAMA 2605 multiple coat, thermally cured fluoropolymer finish system.
        a. Thickness: 1.0 mil total dry film thickness, minimum.
        b. Color: As selected by Architect from manufacturer's custom colors (up to four colors).
    2. Reverse Side: Manufacturer's standard polyester wash coat of 0.3 to 0.4 mil dry film thickness.
B. Stainless Steel/Polymer Fabric Flashing: Self-adhered ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric, and manufacturer's standard, self adhering, stainless steel lap tape.

1. Manufacturers:
    a. York Manufacturing, Inc; York 304: www.yorkmfg.com.
    b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
D. Form material with standing seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams. At wall copings use standing seam joints.
E. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
G. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.
H. All flashings to be installed with continuous 18 gauge galvanized steel hold downs per SMACNA Architectural Sheet Metal Manual, current edition.

2.04 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.
B. Primer: Zinc chromate type.
C. Protective Backing Paint: Zinc molybdate alkyd.
D. Concealed Sealants: Non-curing butyl sealant.
E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
    1. Products:
        a. Franklin International, Inc.; Titebond WeatherMaster Metal Roof Sealant: www.titebond.com.
        b. Substitutions: See Section 01 6000 - Product Requirements.
F. Plastic Cement: ASTM D4586/D4586M, Type 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.
B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Conform to drawing details and SMACNA (ASMM) Architectural Sheet Metal Manual.
B. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.
C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
D. Apply plastic cement compound between metal flashings and felt flashings.

E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
F. Seal metal joints watertight.
G. Slope gutters 1/4 inch per 10 feet, minimum.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4300 - Quality Assurance for field inspection requirements.
B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION 07 6200

SECTION 07 7200

ROOF HATCHES AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Roof Accessory work as is indicated in the drawings and/or specified herein including, but not limited to, the following described items.
B. Roof hatches, manual operation
C. Ladder Safety Post - One required at each ladder to roof
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 3100 - Steel Decking.
B. Section 07 5400 Roofing.
C. Section 07 6200 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
    1. Preparation instructions and recommendations.
    2. Storage and handling requirements and recommendations.
    3. Installation methods.
    4. Maintenance requirements.
C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
D. Warranty Documentation:
    1. Submit manufacturer warranty.
    2. Ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.
    3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.

1.07 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 ROOF HATCHES AND VENTS

A. Basis of Design Manufacturer:
   1. Babcock-Davis , Product - Sunlit Series - Model BRHLA
      a. Ladder Safety Post: Model SPY
B. Manufacturers - Roof Hatches
   1. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
   2. Bilco Company; Type TB (various types and special size): www.bilco.com/#sle.
   3. Dur-Red Products: www.dur-red.com.
   4. Milcor, Inc: www.milcorinc.com.
   5. Nystrom: www.nystrom.com.
   6. MIFAB Manufacturing: www.mifab.com.
   7. Substitutions: See Section 01 6000 - Product Requirements.
C. Roof Hatches , General: Factory-assembled steel frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers.
   2. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
   3. For Ladder Access: Single leaf; refer to drawing for size
D. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Galvanized steel, 14 gage, 0.0747 inch thick.
   2. Finish: Manufacturer's standard factory-applied powder coat.
   3. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
E. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Galvanized steel; outer cover 14 gage, 0.0747 inch thick, liner 22 gage, 0.03 inch thick.
   3. Finish: Manufacturer's standard factory-applied powder coat.
   4. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
   5. Gasket: EPDM, continuous around cover perimeter.
F. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Manufacturer’s recommended type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Manual Release: Pull handle on interior.
   6. Locking: Padlock hasp on interior.

2.02 LADDER SAFETY POST

A. Steel, zinc coated.
B. Install on fixed ladder below hatch cover. Device shall be designed with a telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. Unit shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer’s instructions.

C. Performance Requirements: Fabricate safety post to comply with OSHA 1910.27 for fixed ladders. Must support 200 pound load.
D. Post: 1 1/2" x 1 1/2" Steel square tubing- high strength. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.
E. Finish: Powder coat paint, Safety Yellow.
F. Spring assist: Stainless steel balancing spring mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post.
G. Hardware: All mounting hardware shall be stainless steel.
H. Required at all ladders to roof.
I. Ladder Safety Post, Model LU-1 by Babcock Davis or equal

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 07 7200

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SECTION 07 8400

FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Firestopping work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 01 7700 - Closeout Procedures: Cutting and patching.
B. Section 07 8100 - Applied Fire Protection.
C. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.
D. Division 23 - HVAC: Firestopping of mechanical work.
E. Division 26 - Electrical: Firestopping of electrical work.

1.03 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
B. ICC-ES - International Code Council Evaluation Service; Current.
C. ITS (DIR) - Directory of Listed Products; current edition.
D. FM 4991 - Firestop Contractors; 2013.
E. FM (AG) - FM Approval Guide; current edition.
F. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Certificate from authority having jurisdiction indicating approval of materials used.
G. Manufacturer's qualification statement.
H. Installer's qualification statement.

1.05 QUALITY ASSURANCE

A. The Work of this Section shall be accomplished by a single source contractor or by those contractors who, by their contract, are penetrating rated construction with their work. Regardless of responsibility, the General Contractor shall be responsible to assure and verify that all products, systems, etc. used under this Section are appropriate and meet the intent of this specification and is accomplished by factory trained workmen.
B. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section and:
1. Trained by manufacturer.
2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
3. Verification of minimum three years documented experience installing work of this type.
4. Verification of at least five satisfactorily completed projects of comparable size and type.
5. Licensed by local authorities having jurisdiction (AHJ).

1.06 MOCK-UPS

A. Install one firestopping assembly representative of each fire rating design required on project.
1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.

B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.

C. If accepted, mock-up will represent minimum standard for this work.

D. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

1.08 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
1. Hilti, Inc: www.us.hilti.com.

B. Firestopping Manufacturers:
1. 3M Fire Protection Products: www.3m.com/firestop.
2. A/D Fire Protection Systems Inc: www.adfire.com.
3. Rectorseal, a CSW Industrials Company; Metacaulk 150+ General Purpose Firestop Sealant: www.metacaulk.com.
4. Nelson FireStop Products: www.nelsonfirestop.com.
5. Specified Technologies Inc: www.stifirestop.com.
6. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com.

7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.
B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.
C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. All UL Systems listed are based on one manufacturer's proprietary product as a basis of design. Other approved manufacturers may bid the project, and shall provide corresponding UL Systems for their individual products.
B. Refer to Drawings for required Fire Ratings and UL Systems.

2.04 FIRESTOPPING FOR PERIMETER CONTAINMENT

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.
C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. Install labeling required by code.

3.04 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.05 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words: 'FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS' using lettering no less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
   1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words: 'Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage.'

2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 8400

SECTION 07 9200

JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Joint Sealant work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. This section is intended to not only provide information for the caulking contractor, but also the contractors listed below, who are by this specification required to caulk their own work:
      a. Section 06 4100 - Architectural Casework
      b. Section 06 6116 - Solid Surfacing Fabrications
      c. Section 07 1300 - Below Grade Sheet Waterproofing
      d. Section 07 4213 - Metal Wall Panels
      e. Section 07 4264 - Metal Composite Wall Panels
      f. Section 07 5419 - Single-Ply PVC Thermoplastic Membrane Roofing
      g. Section 07 6200 - Sheet Metal Flashing and Trim
      h. Section 07 8400 - Firestopping.
      i. Section 08 4313 - Aluminum-Framed Storefronts
      j. Section 08 4413 - Glazed Aluminum Curtain Wall
      k. Section 09 3000 - Tiling
      l. Section 09 9123 - Interior Painting
      m. Section 11 4000 - Food Service Equipment.
      n. Division 22 - Plumbing.
      o. If not listed above, the work will be caulked under this section.
B. Nonsag gunnable joint sealants.
C. Self-leveling pourable joint sealants.
D. Silicone joint sealants.
E. Urethane joint sealants.
F. Latex joint sealants.
G. Joint backings and accessories.
H. Do not include sales tax, refer to 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 07 1300 - Below Grade Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.
B. Section 07 2500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
C. Section 07 8400 - Firestopping: Firestopping sealants.
D. Section 08 7100 - Door Hardware: Setting exterior door thresholds in sealant.
E. Section 08 8000 - Glazing: Glazing sealants and accessories.
F. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
G. Section 09 3000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
B. ASTM C834 - Standard Specification for Latex Sealants; 2017.
C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.
G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.04 DEFINITIONS

A. Sealant Types and Classifications:
    1. Type:
        a. Type S: Single-component sealant.
        b. Type M: Multi-component sealant.
    2. Grade:
        a. Grade P: Pourable or self-leveling sealant used for horizontal traffic joints.
        b. Grade NS: Non-sag or gunnable sealant used for vertical and non-traffic joints.
    3. Classes: Represent movement capability in percent of joint width.
        a. Class 100/50: Sealant that, when tested for adhesion or cohesion under cyclic movement shall withstand of at least 100 percent increase and decrease of at least 50 percent of joint width as measured at time of application.
        b. Class 50: Sealant that, when tested for adhesion or cohesion under cyclic movement shall withstand increase and decrease of at least 50 percent of joint width as measured at time of application.
        c. Class 25: Sealant that, when tested for adhesion or cohesion under cyclic movement shall withstand increase and decrease of at least 25 percent of joint width as measured at time of application.
        d. Class 12: Sealant that, when tested for adhesion and cohesion under cyclic movement shall withstand increase and decrease of at least 12 percent of joint width as measured at time of application.
    4. Use:
        a. T (Traffic): Sealant designed for use in joints in pedestrian and vehicular traffic areas such as walkways, plazas, decks and parking garages.
        b. NT (Non-Traffic): Sealant designed for use in joints in non-traffic areas.
        c. I (Immersion): Sealant that meets bond requirements when tested by immersion (Immersion rated sealant applications require primer).
        d. M (Mortar): Sealant that meets bond requirements when tested on mortar specimens.
        e. G (Glass): Sealant that meets bond requirements when tested on glass specimens.
        f. A (Aluminum): Sealant that meets bond requirements when tested on aluminum specimens.
        g. O (Other): Sealant that meets bond requirements when tested on substrates other than standard substrates, being glass, aluminum, mortar.

B. Silicone: Any member of family of polymeric products whose molecular backbone is made up of alternating silicon and oxygen atoms and which has pendant hydrocarbon groups attached to silicon atoms. Used primarily as a sealant. Offers excellent resistance to water and large variations in temperature (minus 100 deg F to + 600 deg F) (minus 73.3 deg C to + 316 deg C).

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Sample product warranty.
   9. Certification by manufacturer indicating that product complies with specification requirements.
C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
D. Manufacturer's Installation Instructions: Indicate special procedures, surface preparation, and perimeter conditions requiring special attention.
E. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
F. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

1.07 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
D. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or other applicable method as recommended by manufacturer.

1.08 MOCK-UP

A. Provide mock-up of sealant joints in conjunction with window and wall under provisions of Section 01 4300.
B. Construct mock-up with specified sealant types and with other components noted.
C. Locate where directed.
D. Mock-up may remain as part of the Work.

1.09 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective work within a One (1) year period after Date of Substantial Completion.
C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
D. The Contractor shall guarantee his work for a period of One (1) years from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nonsag Sealants (Grade - NS): Permits application in joints on vertical surfaces without sagging or slumping.
    1. Dow Corning Corporation: www.dowcorning.com/construction/sle.
    2. Pecora Corporation: www.pecora.com.
    3. Sherwin-Williams Company: www.sherwin-williams.com.
    4. Sika Corporation: www.usa-sika.com.
    5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
    6. Substitutions: See Section 01 6000 - Product Requirements.
B. Self-leveling Sealants (Grade - P): Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
    1. Dow Corning Corporation: www.dowcorning.com/construction/sle.
    2. Pecora Corporation: www.pecora.com.
    3. Sherwin-Williams Company: www.sherwin-williams.com.
    4. Sika Corporation: www.usa-sika.com.
    5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
    6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
    1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
        a. Wall expansion and control joints.
        b. Joints between door, window, and other frames and adjacent construction.
        c. Joints between different exposed materials.
        d. Openings below ledge angles in masonry.
        e. Control, expansion, and soft joints in masonry.
        f. Joints between concrete and other materials.
        g. Joints between metal frames and other materials.
        h. Other exterior joints for which no other sealant is indicated.
        i. Other joints indicated below.
    2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
        a. Joints between door, window, and other frames and adjacent construction.

b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, gaps around ductwork, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
c. Other joints indicated below.

3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   d. Joints where installation of sealant is specified in another section.
   e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
   1. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
   2. Wiring Slots in Concrete Paving: Self-leveling polyurethane sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
   1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
   2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
   3. Floor Joints in Wet Areas: Nonsag polyurethane "traffic-grade" sealant suitable for continuous liquid immersion.
   4. Wall, Ceiling, and Floor Joints Where Tamper-Resistance is Required: Non-sag tamper-resistant polyurethane sealant.
   5. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear.
   6. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
   7. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
   8. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical". Any interior wall with insulation

F. Areas Where Tamper-Resistance is Required: As indicated on drawings.

2.03 NONSAG JOINT SEALANTS

A. Type 1 - Exterior Silicone Sealant: (Non-paintable) ASTM C920, Grade NS, Uses M,T,NT,G,O and A; not expected to withstand continuous water immersion or traffic.
   1. Applications: Use for:
   2. Movement Capability: Plus and minus 25 percent, minimum.
   3. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   4. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   5. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
   6. Color: To be selected by Architect from manufacturer's standard range.
   7. Cure Type: Single-component, neutral moisture curing.
   8. Service Temperature Range: Minus 20 to 180 degrees F.
   9. Manufacturers:
      a. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.

b. Sika Corporation: Sikasil WS 290 Silicone Building Sealant, www.usa.sika.com
c. Substitutions: See Section 01 6000 - Product Requirements.

B. Type 2 - General Purpose Interior Silicone Sealant: ASTM C920, Grade NS, Uses M,T,NT,G,O and A; not expected to withstand continuous water immersion or traffic.Contains Anti-Microbial additive for mold resistance.
1. Applications: Use for:
a. General purpose interior locations.
b. Hardwood trim.
c. Glazing
d. Kitchen / Bath Countertops
2. Movement Capability: Plus and minus 25 percent, minimum.
3. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
4. Color: To be selected by Architect from manufacturer's standard range.
5. Cure Type: Single-component, neutral moisture curing
6. Service Temperature Range: Minus 65 to 180 degrees F.
7. Manufacturers:
a. Sika Corporation; Sikasil GP: www.usa.sika.com
b. Substitutions: See Section 01 6000 - Product Requirements.

C. Type 3 - General Purpose Exterior - Non-Sag Sealant: Polyurethane (Paintable) ASTM C920, Grade NS, Uses M, T, NT, G, O, I and A; Type: multi-component.
1. Applications: Use for:
a. Control, expansion, and soft joints in masonry.
b. Joints between concrete and other materials.
c. Joints between metal frames and other materials.
d. Joints between exterior door and window frames and wall surfaces.
e. Other exterior joints for which no other sealant is indicated.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's custom range.
4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Manufacturers:
a. Sika Corporation; Sikaflex-2c NS: www.usa.sika.com
1) Use in vertical and horizontal expansion joints, window perimeter, in EIFS, joints in constantly submerged conditions, joints and penetration details requiring UL flame spread ratings. It can also be overpainted with water, oil and rubber based paints for project requiring coatings work.
b. Substitutions: See Section 01 6000 - Product Requirements.

D. Type 4 - General Purpose Interior Sealant (Paintable) - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's custom range.
2. Grade: ASTM C834; Grade - NF.
3. Applications: Use for:
a. Interior wall and ceiling control and expansion joints.
1) Include compatible backer rod.
b. Joints between interior wall surfaces and frames of interior doors, windows, louvers, elevator entrances and similar openings.
c. Other interior joints for which no other type of sealant is indicated.
4. Products:
a. Pecora Corporation; AC-20 + Silicone Acrylic Latex Caulking Compound:
b. Substitutions: See Section 01 6000 - Product Requirements.

E. Type 5 - Acoustical Sealant for Concealed Locations, Fire Rated - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
   1. Applications: Use for concealed locations only in sound rated assemblies:
      a. Sealant bead between top stud runner and structure and between bottom stud track and floor.
   2. Manufacturers:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant:
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 SELF- LEVELING SEALANTS

A. Type[6]- Self-Leveling Polyurethane Sealant (paintable): ASTM C920, Grade P, Uses: T, M, NT, G, O, A and I; Type: multi-component explicitly approved by manufacturer for traffic exposure; and continous water immersion.
   1. Applications: Use for:
      a. Control and Expansion Joints in sidewalks and vehicular paving.
   2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
   3. Color: To be selected by Architect from manufacturer's standard range.
   4. Service Temperature Range: Minus 40 to 180 degrees F.
   5. Manufacturers:
      a. Sika Corporation; Sikaflex-2c SL: www.usa.sika.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Type 7 - Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling narrow cracks and saw cut control joints not subject to significant movement.
   1. Applications: Use for:
      a. Joints in sidewalks and vehicular parking
      b. Tamper resistant sealant
   2. Color: Color as selected.
   3. Composition: Multi-component, 100 percent solids by weight.
   4. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
   5. Joint Width, Minimum: 1/8 inch.
   6. Joint Width, Maximum: 1/4 inch.
   7. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
   8. Manufacturers:
      a. Sika Corporation; Sikadur 51 SL www.usa-sika.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.
   1. Examine substrate(s) with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
   2. Installer to proceed with installation only after unsatisfactory conditions have been corrected and/or that installation of sealant constitutes acceptance from the installer of acceptable substrate conditions.
B. Verify that backing materials are compatible with sealants.
C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.
D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.
E. Install bond breaker backing tape where backer rod cannot be used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION 07 9200

SECTION 08 1113

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Hollow Metal Door and Frame work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Non-fire-rated hollow metal doors and frames.
C. Non-fire rated hollow metal frames for wood doors.
D. Fire-rated hollow metal doors and frames.
E. Interior fire resistive rated metal frames.
    1. Applications:
        a. Doors with transoms.
F. Thermally insulated hollow metal doors with frames.
G. Sound-rated steel frames.
H. Door hardware.
    1. Provide hardware and installation for work associated with this section as scheduled by Section 08 7100.
I. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 08 1416 - Flush Wood Doors.
B. Section 08 7100 - Door Hardware.
C. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
D. Section 09 9113 - Exterior Painting: Field painting.
E. Section 09 9123 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.
B. ASCE: American Society of Civil Engineers.
C. HMMA: Hollow Metal Manufacturers Association.
D. NAAMM: National Association of Architectural Metal Manufacturers.
E. NFPA: National Fire Protection Association.
F. SDI: Steel Door Institute.
G. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2018.
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
J. ASTM E413 - Classification for Rating Sound Insulation; 2016.
K. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames; 2016.
L. ITS (DIR) - Directory of Listed Products; current edition.
M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
O. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.
P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
R. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2019.
S. UL (DIR) - Online Certifications Directory; Current Edition.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
D. Samples: Submit two samples of metal, 2 by 2 inches in size, showing factory finishes, colors, and surface texture.
E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
F. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
C. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

1.08 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
   3. De La Fontaine Inc: www.delafontaine.com.
   4. Republic Doors, an Allegion brand: www.republicdoor.com.
   5. Steelcraft, an Allegion brand: www.allegion.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Hardware Preparations, Selections, and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
   3. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finishes, all doors: Factory primed and field finished.
B. Exterior Doors: Thermally insulated.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 4 - Maximum-duty. Linked to Door Metal Thickness below.
      b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
   3. Door Thickness: 1-3/4 inches, nominal.
   4. Weatherstripping: Refer to Section 08 7100.
C. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 3 - Extra Heavy-duty. Linked to Door Metal Thickness below.
b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches, nominal.

D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 3 - Extra Heavy-duty.
b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
c. Attach fire rating label to each fire rated unit.
3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: 1-3/4 inches, nominal.

E. Sound-Rated Interior Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 4 - Maximum-duty.
b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 1 - Full Flush.
d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.
e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Steel Face Thickness: 0.053 inch (1.3 mm); 16 gauge.
3. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 39, minimum, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
4. Door Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
5. Door Thickness: As required to meet acoustic requirements indicated.
6. Sound Seals: Integral, in door and/or frame.
7. Opening Force of Sound-Rated Doors, Non-Fire-Rated: 5 pounds, maximum, in compliance with ADA Standards.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
B. Frame Finish: Same as hollow metal door.
C. General:
1. Comply with the requirements of grade specified for corresponding door.
a. ANSI/SDI A250.8 Level 3 Doors: 14 gauge, 0.067 inch, minimum frames.

b. ANSI/SDI A250.8 Level 4 Doors: 12 gauge, 0.093, minimum frames.
c. Frames for Wood Doors: 14 gauge, 0.067 inch, minimum.

2. Provide frames with a minimum of six wall anchors and two adjustable base anchors of manufacturer's standard design.
3. Comply with recommended practice for hardware placement amd reinforcement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

D. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
2. Frame Metal Thickness: 12 gauge, 0.093 inch, minimum.
3. Weatherstripping: Separate, see Section 08 7100.

E. Interior Door Frames, Non-Fire-Rated: Fully welded type, ground smooth, fully prepared and reinforced for hardware installation, seamless with joints filled.
1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
2. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.

F. Interior Door Frames, Fire-Rated: Fully welded type, ground smooth, fully prepared and reinforced for hardware installation, seamless with joints filled.
1. Fire Rating: Same as door, labeled.
2. Some transoms have 1 9/16 inch fire rated glass.
3. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
4. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.

G. Interior fire resistive rated frames.
1. Frames shall be tested by ASTM E119 / UL 263.
2. Rating: 120 minute fire resistive.
3. Product: E119 Fire Resistive Frames by Ceco Door - www.cecodoor.com.
4. Finish: Primed.

H. Sound-Rated Door Frames: Fully welded type, seamless with joints filled.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.
C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.
1. Epoxy paint or self-adhered waterproof membrane may also be used.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Install fire-rated units in accordance with NFPA 80.
C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
E. Door Hardware: Provide hardware and installation for work associated with this section as scheduled by Section 08 7100.
    1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
F. Comply with glazing installation requirements of Section 08 8000.
G. Coordinate installation of electrical connections to electrical hardware items.
H. Touch up damaged factory finishes.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.
B. Adjust sound control doors so that seals are fully engaged when door is closed.
C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

3.06 SCHEDULE

A. Refer to Door Schedule on the drawings.

END OF SECTION 08 1113

SECTION 08 1416

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Flush Wood Door work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Flush wood doors; flush and flush glazed configuration; fire rated, non-rated, acoustical, and special function.
   1. Sound-rated doors to be provided at all Music Rooms, and other areas as noted on Drawings.
C. Door hardware.
   1. Provide hardware and installation for work associated with this section as scheduled by Section 08 7100.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 08 1113 - Hollow Metal Doors and Frames.
B. Section 08 7100 - Door Hardware.
C. Section 08 8000 - Glazing

1.03 REFERENCE STANDARDS

A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
B. ASTM E413 - Classification for Rating Sound Insulation; 2016.
C. AWI (QCP) - Quality Certification Program; Current Edition.
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
G. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
H. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Indicate door core materials and construction, veneer species, type, and characteristics.
C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
D. Samples: Submit two samples of door construction, 8 inches by 8 inches in size cut from top corner of door.
E. Samples: Submit two samples of door veneer, 8 inches by 8 inches in size illustrating wood grain, stain color, and sheen.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
G. Test Reports: Show compliance with specified requirements for the following:
    1. Sound-rated doors and frames; sealed panel tests are not acceptable.
H. Samples: Submit two samples of edgebanding, 6 inches (150 mm) in length illustrating color and pattern.
I. Manufacturer's Installation Instructions: Indicate special installation instructions.
J. Manufacturer's qualification statement.
K. Specimen warranty.
L. Warranty, executed in Cache County School District 's name.

1.05 QUALITY ASSURANCE

A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with no less than three years of documented experience.
    1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
    2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with no less than three years of documented experience.
D. Woodwork Quality Assurance Program:
    1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
    2. Provide labels indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
    3. Provide designated labels on shop drawings as required by quality assurance program.
    4. Provide designated labels on installed products as required by quality assurance program.
    5. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.
E. Single-Source Responsibility: Obtain doors from one source and by a single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver, and store doors in accordance with specified quality standard.
B. Accept doors on site in manufacturer's packaging, and inspect for damage.
C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.
D. Contractor shall use all means necessary to protect doors from damage prior to, during, and after installation. All damaged doors shall be repaired or replaced by the Contractor at no cost to the Owner.
E. Doors shall be palletized at factory in stack of no more than 30 doors per pallet. Door edges shall be protected with heavy corner guards.

1.07 PROJECT CONDITIONS

A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of the construction period to comply with the following requirements applicable to Project’s geographical location:

1. AWS quality standard Section 2 Care and Storage.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Masonite Architectural. Product: Aspiro Series. Species: White Maple. Stain Color: Cocoa Bean. www.masonite.com.
B. Other Approved Manufacturers:
   1. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
   2. Wood Veneer-Faced Doors: 5-ply unless otherwise indicated.
   3. Glazed Lights: Factory glazed sizes and configurations as indicated on drawings.
B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
   3. Sound Rated Doors: Minimum STC of 45, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
      a. For Music Room, minimum STC of 60, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
   4. Wood veneer facing with factory transparent finish as selected by architect.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
C. Sound-Rated Doors: Equivalent to type, with acoustic core construction as required to achieve STC rating specified; plies and faces as indicated above.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Select White Maple, Premium HPVA Grade A, plain sliced (flat cut), with book match between leaves of veneer, center balance match of spliced veneer leaves assembled on door or panel face.
   1. Veneers shall be 5 inches minimum width.
   2. Vertical Edges: 1/8 inch (3 mm) PVC wood grain edgebanding to match wood veneer. Edgebanding selection to be approved by Architect.
      a. PVC on both vertical edges.

3. Pair Match each pair of doors; Set Match pairs of doors within 10 feet of each other when doors are closed.

B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.
B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.
C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
G. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 11 Polyurethane Catalyzed.
         1) AWI Section 1500, System TR-6 may also be used.
      b. Stain: Custom color as selected/approved by Architect.
      c. Sheen: Satin.
B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
C. Factory finish doors in accordance with approved sample.
D. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08 1113.
B. Glazing: See Section 08 8000.
C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
   1. Non-Rated and 20 Minute: Flush, wood of same species as door facing.
      a. Acceptable Profile: Marshfield Type W-6.
   2. Fire-Rated 45 Minute or Above: Flush, wood veneer clad PVC, of same species as door facing.
D. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.
E. Door Hardware: Provide hardware and installation for work associated with this section as scheduled by Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.
B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
C. Use machine tools to cut or drill for hardware.
D. Coordinate installation of doors with installation of frames and hardware.
E. Coordinate installation of glazing.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.
B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.
B. Adjust closers for full closure.

3.05 SCHEDULE- SEE DRAWINGS

END OF SECTION 08 1416

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SECTION 08 3323

OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Overhead Coiling Door work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Overhead coiling doors, and operating hardware.
   1. Exterior.
   2. Insulated.
   3. Non fire-rated.
   4. Electric operation.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
B. Section 08 7100 - Door Hardware: Cylinder cores and keys.
C. Division 26 - Conduit: All conduit from electric circuit to operator and from operator to control station.
D. Division 26 - Conduit: Conduit from fire alarm system.
E. Division 26 - Equipment Wiring: Disconnect switch and wiring.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
E. ITS (DIR) - Directory of Listed Products; current edition.
F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
H. UL (DIR) - Online Certifications Directory; Current Edition.
I. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide general construction, component connections and details, electrical equipment.
C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

E. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.06 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.
B. Manufacturer shall warranty overhead coiling door for a period of One (1) yearfrom date of Substantial Completion against defects in material and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
    1. Cornell Iron Works, Inc: www.cornelliron.com.
B. Other Manufacturers: Subject to compliance with all of the requirements of this section, products by one of the following will be acceptable:
    1. Alpine Overhead Doors, Inc: www.alpinedoors.com.
    2. Cornell Iron Works, Inc: www.cornelliron.com.
    3. Raynor Rolling Doors: www.raynor.com.
    4. The Cookson Company: www.cooksondoor.com.
    5. Overhead Door Corp: www.overheaddoor.com.
    6. Porvene Doors: www.porvenedoors.com.
    7. Mckeon Door Company : www.mckeondoor.com.
    8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COILING DOORS

A. Exterior Coiling Doors: Insulated Steel, Stainless steel or aluminum slat curtain.
    1. Locations: Exterior Storage C230, Receiving C233.
    2. Capable of withstanding positive and negative wind loads of 20 psf without undue deflection or damage to components.
    3. Single Thickness Slats: Manufacturer's standard.
    4. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1.
        a. Vision Lites: Dual pane glazed.
            1) Material: Manufacturer's standard polycarbonate sheet with proprietary abrasion resistant surfaces.
            2) Size: As indicated in drawings.
            3) Size: 3 inches by 5/8 inch.
            4) Spacing: Manufacturer's standard for door width.
            5) Location on Door Curtain: As indicated on drawings.
    5. Nominal Slat Size: 3 inches high by 7/8 inch (22 mm) deep.
    6. Finish: Factory applied Thermoset Powder Coating, 2 mils thick minimum, custom color by architect.
    7. Bottom Bar: Two 1/8-inch steel angles mechanically joined together with a 1-inch diameter vinyl covered foam edge astragal/threshold seal continuous along the bottom. Finish on the bottom bar is as indicated for the curtain.

8. Guides: Three steel angles bolted together with 3/8-inch fasteners to form a channel for the curtain to travel; to include an extruded vinyl snap-on weatherstripping continuously along the exterior leg of the guide. Ensure the wall angle portion is continuous and fastened to the surrounding structure with either minimum 1/2-inch fasteners or welds, both on 36-inch centers. Finish on the guide angles as indicated for the curtain.
9. Brackets: Constructed of steel no less than 1/4 inch thick and bolted to the wall angle with minimum 1/2-inch fasteners. Finish on the brackets as indicated for the curtain.
10. Gears: Cast iron with teeth cast from machine-cut patterns. Pinion gear of no less than a 3-inch pitch diameter. Gear ratio designed for a maximum effort of no more than 30 pounds.
11. Barrel: Steel tubing of no less than 6 inches in diameter. Oil-tempered torsion springs shall be capable of correctly counter balancing the weight of the curtain. The barrel shall be designed to limit the maximum deflection to .03 inches per foot of opening width. The springs shall be adjusted by means of an exterior wheel. The finish on the barrel shall be one (1) coat of bronze rust-inhibiting prime paint.
12. Hood Enclosure: 24-gauge galvanized steel and formed to fit the curvature of the brackets. Hood to contain a waterproof baffle to control air infiltration. Hood finish shall be as indicated for the curtain.
    a. Enclosure to conceal barrel and gear assemblies.
13. Weatherseals:
    a. Vinyl bottom seal, exterior guide and internal hood seals and air infiltration package are optional. Delete if not required.
    b. Interior guide weatherseal.
    c. Lintel weatherseal.
    d. Air Infiltration Package, IECC 2012/2015 listed; product to meet C402.4.3 2012 Air leakage <1.00 cfm/ft2.
        1) Air infiltration perimeter seal package includes: guide cover, guide cap, dual brush exterior guide seal, 4-inch finned lintel brush seal and vinyl bottom seal.
14. Electric Operation.
15. Mounting: Surface mounted.
16. Locking Mechanism: The chain door shall be secured by means of a chain lock.
17. Acceptable Product: Type FCWI - Chain Operated Insulated Service Door manufactured by The Cookson Company.

2.03 MATERIALS AND COMPONENTS

A. Curtain Construction: Interlocking slats.
    1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
    2. Mounting: Surface mounted.
    3. Curtain Bottom: Extruded tubular aluminum bottom bar with vinyl astragal.
B. Steel Slats: Minimum thickness 22 gage (0.76 mm thick); ASTM A653/A653M galvanized steel sheet.
C. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.
    1. Formed from galvanized steel sheet, complying with ASTM A653/A653M.
    2. Galvanizing: Minimum G90/Z275 coating.
D. Guides - Angle: ASTM A36/A36M metal angles, size as indicated.
    1. Hot-dip galvanized in compliance with ASTM A123/A123M.
E. Hood Enclosure: Aluminum with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets as required to prevent excessive sag.
    1. Finish: Clear anodized.

F. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
   1. Provide interlock switches on motor operated units.
B. Electric Operators:
   1. Supply Electric Tube Motor Operator - Rated for a maximum of 10 cycles per day, cULus recognized, rated as recommended by door manufacturer for size and type of door, 110 Volts, 1 Phase. Provide complete with electric tube motor, maintenance free electric brake, emergency manual crank hoist and control stations. Motor shall be protected against overload with an auto-reset thermal sensing device. Operator shall be equipped with an emergency manual crank hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual crank hoist. Operator shall be capable of 10-14 RPM. Fully adjustable, mechanical internal worm limit switch mechanism shall synchronize the operator with the door.
C. Control Station: Provide standard three button, Open-Close-Stop momentary-contact control device for each operator complying with UL 325.
   1. 24 volt circuit.
   2. Surface mounted, at interior door jamb.
   3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
      a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.
D. Safety Edge: Located at bottom of curtain, full width, electro-mechanical sensitized type, wired to stop operator upon striking object, hollow neoprene covered.
   1. Manufacturers:
      a. Miller Edge, Inc: www.milleredge.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances, and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.
B. Install fire-rated doors in accordance with NFPA 80.
C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
F. Coordinate installation of electrical service with Section 26 0583.
G. Coordinate installation of electrical service with Division 26 - Electrical.
H. Complete wiring from disconnect to unit components.
I. Complete wiring from fire alarm system.
J. Install enclosure and perimeter trim.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.
B. Maximum Variation From Plumb: 1/16 inch.
C. Maximum Variation From Level: 1/16 inch.
D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.
B. Remove labels and visible markings.

END OF SECTION 08 3323

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SECTION 08 4313

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Aluminum Framed Storefront work as is indicated on the drawings or specified herein including, but not limited to, the following described items.
B. Aluminum-framed storefront and windows.
C. Infill panels of glass.
D. Shadow box.
E. Door hardware.
    1. Provide hardware and installation for work associated with this section as scheduled by Section 08 7100.
F. Furnish and install all detailed matching aluminum brake metal closures and trim.
G. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 1200 - Structural Steel Framing: Steel attachment members.
B. Section 05 5000 - Metal Fabrications: Steel attachment devices.
C. Section 07 2500 - Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.
D. Section 07 8400 - Firestopping: Firestop at system junction with structure.
E. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
F. Section 08 4413 - Glazed Aluminum Curtain Wall.
G. Section 08 7100 - Door Hardware: Hardware items other than those specified in this section.
H. Section 08 8000 - Glazing: Glass and glazing accessories.
I. Section 12 2413 - Roller Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
C. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
M. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Cache County School District 's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Correct defective Work within a five year period after Date of Substantial Completion.
C. Provide five-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
D. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
    1. Kawneer North America: www.kawneer.com.
        a. Exterior Storefront System: Trifab VG 451T; Thermal System.
        b. Interior Storefront System: Trifab VG 450.
        c. Swing Doors:
            1) 500 Heavy Wall Door (Wide Stile).
                (a) All interior aluminum doors (vestibule and offices, etc.).
            2) 500T Insulpour Door Thermal at Non-Vestibule, Exterior Conditions.
B. Other Manufacturers: Subject to compliance with all of the requirements of this section, products by one of the following will be acceptable:
    1. C.R. Laurence Company, Inc; U.S. Aluminum: www.crl-arch.com.
    2. Oldcastle Building Envelope: www.oldcastlebe.com.
    3. Tubelite, Inc: www.tubeliteinc.com.
    4. EFCO Corp: www.efcocorp.com.
    5. Arcadia: www.arcadiainc.com.
    6. Manko Window System, Inc., www.mankowindows.com.
    7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. This Contractor/Manufacturer, along with Section 08 8000, shall certify that the specified storefront/glazing assembly meets or exceeds the Utah Energy Code standards (based on ICC (IECC)) as a part of submittal approval.
    1. Minimum Storefront Assembly Overall Design U-Value: 0.50.
    2. Minimum Storefront Assembly Overall Design Solar Heat Gain Coefficient: 0.48.
B. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
    1. Design Wind Loads: Comply with requirements of ICC (IBC)
    2. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
C. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
D. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft (0.3 L/s/sq m) of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
E. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch (25 mm) insulating glass installed.
F. Water Leakage: None, when measured in accordance with ASTM E331 at specified pressure differential.

G. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
H. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line withinside pane of glass and heel bead of glazing compound.
I. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12-hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.03 EXTERIOR STOREFRONT SYSTEM

A. Aluminum-Framed Storefront: Factory fabricated, factory finished, tubular aluminum framing members, thermally broken with interior section insulated from exterior, drainage holes, internal weep drainage system, related flashings, anchorage and attachment devices.
    1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
        a. As required to meet structural loading requirements.
        b. Vertical mullions adjacent to doors to prevent unwanted twisting mullion.
    2. Unitized, shop assembly.
    3. Front - set.
    4. Glazing Stops: Flush. Type for 1 inch (25 mm) insulating glazing.
    5. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
    6. Water Leakage Test Pressure Differential: 8.00 lbf/sq ft.
    7. Air Infiltration Test Pressure Differential: 6.24 psf.
    8. Condensation Resistance Factor: 35 (thermally broken) minimum.
    9. Finish: Class I natural anodized and black as indicated on drawings.

2.04 INTERIOR STOREFRONT SYSTEM

A. Aluminum-Framed Storefront: Factory fabricated, factory finished, tubular aluminum framing members, anchorage and attachment devices.
    1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
    2. Unitized, shop assembly.
    3. Glazing Position: Centered (front to back).
    4. Glazing Stops: Flush. Type for 1/4 inch (6 mm) monolithic glazing.
    5. Vertical Mullion Dimensions: 1 3/4 inches wide by 4 1/2 inches deep.
    6. Finish: Class I natural anodized.

2.05 DOORS

A. Performance Requirements:
    1. Air Infiltration: For single acting offset pivot or butt hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E283 at a pressure differential of 6.24 psf (300 Pa) for single doors and 1.567 psf (75 Pa) for pairs of doors. A single 36 inch by 84 inch (915 mm by 2134 mm) entrance door and frame shall not exceed 0.50 cfm per square foot. A pair of 72 inch by 84 inch (1830 mm by 2134 mm) entrance doors and frame shall not exceed 1.0 cfm per square foot.
    2. Structural: Corner strength shall be tested and certified by an independent testing laboratory to ensure weld compliance and corner integrity.
B. Glazed Aluminum Doors: Wide stile, Heavy Wall with hardware and components.
    1. Thickness: 2 inches.

2. Top Rail: 5 inches wide.
3. Vertical Stiles: 5 inches wide.
4. Wall Thickness: 0.188 inches (4.8 mm).
5. Bottom Rail: 10 inches high.
6. Glazing Stops: Square.
7. Finish: Class I natural anodized.

C. Glazed Aluminum Door at Non-Vestibule Conditions: Wide stile, thermally broke, with hardware and components.
1. Thickness: 2-1/4 inches.
2. Top Rail: 5 inches wide.
3. Vertical Stiles: 5 inches wide.
4. Wall Thickness: 0.125 inches (3.2 mm).
5. Bottom Rail: 10 inches high.
6. Glazing Stops: Square.
7. Finish: Same as storefront.
8. Finish: Class I natural anodized.

2.06 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing stops: Flush. Type for 1 inch (exterior) and 1/4 inch (interior) glazing.
3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M); 6063-T6 alloy and temper.
B. Sheet Aluminum: ASTM B209/B209M.
C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
D. Fasteners: Stainless steel, where exposed.
E. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
F. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
G. Perimeter Sealant: As recommended by manufacturer for project specific conditions.
H. Glazing Gaskets: Extruded EPDM rubber. Type to suit application to achieve weather, moisture, and air infiltration requirements.
I. Glazing Accessories: See Section 08 8000.
J. Thermal Barrier: Thermal break with a 1/4 inch (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
K. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.08 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M10C21A41 Clear anodic coating not less than 0.7 mils thick.
B. Class I Black Anodized Finish: AAMA 611 AA-M10C21A41 Electrolytically deposited colored anodic coating not less than 0.7 mils thick. Color: #29 Black.
C. Color: As indicated on drawings.

D. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.09 HARDWARE

A. Door Hardware: Provide hardware and installation for work associated with this section as scheduled by Section 08 7100.
B. Interior (Non-Exit) Door Push/Pull: Kawneer CO-9/CP-11.
C. Interior (Exit) Door Push/Pull: Kawneer CO-9 (Push by Section 08 7100).
D. Weatherstripping:
    1. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.
    2. The door weathering on a single action offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
E. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners.
F. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

2.10 ACCESSORIES

A. Storefront Removable Mullion: Between doors type.
    1. Top mount.
    2. Between threshold mount.
    3. Key operated.
    4. Base Bid Manufacturer:
        a. Jenkins Glass and Doors; Product - GRM 1995: (208) 523-5173 (Idaho Falls, ID).
        b. Substitutions: See Section 01 6000 - Product Requirements.

2.11 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
C. Prepare components to receive anchor devices. Fabricate anchors.
D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
    1. Epoxy paint or self-adhered waterproof membrane may also be used.
E. Arrange fasteners and attachments to conceal from view.
F. Reinforce interior horizontal head rail to receive roller window shade brackets and attachments.
G. Reinforce components internally for door hardware and door operators.
H. Reinforce framing members for imposed loads.
I. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
    1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.
B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
J. Install operating sash.
K. Set thresholds in bed of sealant and secure.
L. Install hardware using templates provided.
    1. See Section 08 7100 for hardware installation requirements.
M. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 08 8000.
N. Install infill panels, refer to drawings.
O. Install perimeter sealant in accordance with manufacturer's written instructions.
P. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 4313

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SECTION 08 4413

GLAZED ALUMINUM CURTAIN WALL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Aluminum Curtain Wall work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Aluminum-framed curtain wall, with vision glazing and glass and metal infill panels.
   1. Including perimeter trims, stools, accessories, shims and anchors.
   2. Insulated infill panels.
C. Furnish and install all detailed matching aluminum brake metal closures and trim.
D. Structural steel within or needed for Curtain Wall to be furnished by this Contractor.
E. Firestopping between curtain wall and edge of floor slab.
F. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Weld plates embedded in concrete for attachment of anchors.
B. Section 05 1200 - Structural Steel Framing: Steel attachment members.
C. Section 05 5000 - Metal Fabrications: Steel attachment devices.
D. Section 07 2500 - Weather Barriers: Perimeter air seal between glazing system and adjacent construction.
E. Section 07 8400 - Firestopping: Firestop at system junction with structure.
F. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
G. Section 08 4313 - Aluminum-Framed Storefronts: Entrance framing and doors.
H. Section 08 8000 - Glazing
I. Section 09 2116 - Gypsum Board Assemblies: Metal stud and gypsum board wall at interior of curtain wall.
J. Section 12 2413 - Roller Window Shades: Attachments to framing members.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
B. AAMA 501.1 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure; 2017.
C. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
D. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift; 2018.
E. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
F. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
G. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
H. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2021.

I. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
J. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
L. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
M. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
N. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants; 2005 (Reapproved 2017).
O. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
P. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
Q. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
R. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants; 2019.
S. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2018, with Editorial Revision.
T. ASTM C1249 - Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications; 2018.
U. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2014.
V. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
W. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
X. ASTM E413 - Classification for Rating Sound Insulation; 2016.
Y. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference; 2000 (Reapproved 2016).
Z. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.
AA. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
BB. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
CC. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glazing and infill, and internal drainage details.
C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.

D. Shop Drawings: Provide details of proposed structural sealant glazing (SSG) and weather sealant joints indicating dimensions, materials, bite, thicknesses, profile, and support framing.
E. Samples: Submit two samples 12 inches by 12 inches in size illustrating finished aluminum surface, glazing, infill panels, and glazing materials.
F. Structural Sealant Glazing (SSG): Submit product data and calculations showing compliance with performance requirements.
G. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Cache County School District 's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
B. Full-Size Mock-up Testing: Have a specimen representative of project conditions tested by an independent testing agency for compliance with specified thermal, structural, air infiltration, water penetration, and sound attenuation criteria.
C. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions, and color.
D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
    1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
        a. Insulating Glass Certification Council (IGCC).
E. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 MOCK-UPS

A. See Section 01 4300 - Quality Assurance for additional requirements.
B. Provide 10 feet mock-up including each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
C. Locate on-site where directed by Architect; mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.09 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Correct defective Work within a five-year period after Date of Substantial Completion.

C. Provide five-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
D. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Kawneer Company, Inc: www.kawneer.com.
      a. Products:
         1) Clearwall Curtain Wall; outside glazed.
         2) Clearwall Curtain Wall; structural silicone glazed.
         3) Clearwall Curtain Wall (SSIT).
B. Other Manufacturers: Subject to compliance with all of the requirements of this section, products by one of the following will be acceptable:
   1. Arcadia, Inc: www.arcadiainc.com.

2.02 CURTAIN WALL

A. Type 2 - Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
   2. Outside glazed, with pressure plate and mullion cover, at vertical locations.
   3. Outside glazed, with pressure plate and mullion cover, at horizontal locations.
   4. Structural sealant glazing (SSG) adhesive on two (2) sides, with temporary glazing stops, and pressure plate and mullion cover on 2sides, where indicated on drawings.
   5. Structural sealant glazing (SSG) adhesive on four (4)-sides, with temporary glazing stops, where indicated on drawings.
   6. Fabrication Method: Shop/factory unitized system.
   7. Glazing Method: Either shop/factory or field glazed system.
   8. Mullion Dimensions: 2 1/2 inches wide by 5 7/8 inches deep.
   9. Finish: Class I Color (Black) anodized.
      a. Factory finish surfaces that will be exposed in completed assemblies.
      b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
         1) Epoxy paint or self adhered waterproof membrane may also be used.
   10. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   11. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent stack effect in internal spaces.
   12. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   13. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
   14. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   15. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.

B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the requirements of the ICC (IBC) Code and ASCE 7.
      a. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
      b. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
      c. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
   2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with the requirements of the ICC (IBC) Code and ASCE 7.
   3. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
   4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.
      e. Shortening of structural concrete columns.
      f. Creep of structural concrete members.
   5. Structural Sealant Glazing (SSG) System: For individual glass lites, design framing members to not exceed a deflection normal to the wall of L/175 between supports with 3/4 inch maximum, and a deflection parallel to the wall of L/360 with 1/8 inch maximum, whichever is less.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Method: AAMA 501.1.

D. Thermal Performance Requirements:
   1. This Contractor/Manufacturer along with Section 08 8000, shall certify that the specified curtainwall/glazing assembly meets or exceeds the Utah Energy Code standards (based on ICC (IECC)) as a part of submittal approval.
      a. Minimum Curtain Wall Assembly Overall Design U-Value: 0.34.
      b. Minimum Curtain Wall Assembly Overall Design Solar Heat Gain Coefficient: 0.40.

E. Acoustical Performance Requirements:
   1. Sound Attenuation: STC of 31 at Captured and 32 at SSG, minimum, from exterior to interior.
   2. Test Method: ASTM E90, with calculation in accordance with ASTM E413.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Framing members for interior applications need not be thermally broken.
   2. Cross-Section: As indicated on drawings.

3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: As specified in Section 08 8000.

2.04 MATERIALS

A. Sheet Aluminum: ASTM B209/B209M.
B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
C. Structural Supporting Anchors: See Section 05 1200.
D. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
E. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.
F. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
G. Firestopping: See Section 07 8400.
H. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
    1. SSG adhesive in compliance with ASTM C920; Type S - Single-component, Grade NS, Class 50, Use NT, G, and A.
    2. Ultimate Tensile Strength: Minimum of 50 psi as determined by test method ASTM C1135 under the following conditions.
        a. Exposure to air temperatures of 190 degrees F and minus 20 degrees F.
        b. Water immersion for seven (7) days, minimum.
        c. Exposure to weathering for 5,000 hours, minimum.
    3. Sealant Design Tensile Strength: 20 psi, maximum.
    4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
    5. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
I. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.
J. Perimeter Sealant: Type recommended by manufacturer.
K. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.
L. Aluminum plate panels and back-up attachment angles shall be finished to match curtain wall / storefront system.
M. All required 3/32 inch (3 mm) thick cover plates detailed adjacent to curtain wall framing.

2.05 FINISHES

A. Class I Black Anodized Finish: AAMA 611 AA-M10C21A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.
B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.
C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Install firestopping at each floor slab edge.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Pressure Plate Framing: Install glazing and infill panels using exterior dry glazing method; see Section 08 8000.
J. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.
K. Install infill panels, refer to drawings.
L. Install perimeter sealant.
M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.
B. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements.
    1. Test installed curtainwall assembly for water leakage in accordance with AAMA 501.2.
C. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.
B. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610 and manufacturer's cleaning instructions.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 4413

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SECTION 08 7100
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
      10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
   b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
   b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Fire door assemblies, in compliance with NFPA 80.
   b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage ND Series: 10 years
        2) Exit Devices
            a) Von Duprin: 10 years
        3) Closers
            a) LCN 4000 Series: 30 years
        4) Automatic Operators
            a) LCN: 2 years
    b. Electrical Warranty
        1) Locks
            a) Schlage: 3 years
        2) Exit Devices
            a) Von Duprin: 3 years

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Rockwood
   b. Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage ND series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
   a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
   b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
   c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
   d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
   e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
   b. Lever Design: RHODES (RHO)

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
17. Special Options:
    a. SI
       1) Provide dogging indicators for visible indication of dogging status.
    b. XP
       1) Rim Exit Devices: provide devices with non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress and Static Load Resistance of 2000 pounds.
    c. QM
       1) Rim Exit Devices: provide devices with damper-controlled re-latching to reduce operational noise. Where lever trim is specified, provide damper controlled lever return.
    d. HH
       1) Provide wind and impact rated hurricane exit devices and mullions certified to comply with Florida Building Code (FBC) TAS 201, 202, 203.
    e. HW
       1) Provide wind rated hurricane exit devices and mullions certified to comply with ANSI-ASTM E330.
    f. CX

1) Provide delayed egress devices, where scheduled, that are UL 294 listed, meet National Fire Protection Association (NFPA) and International Building Code (IBC) governing delayed egress, and/or other local and national fire codes acceptable to authority having jurisdiction as required.
   a) Provide non-handed and field sizable device with 3/4 (19mm) throw deadlocking latch bolt. Device incorporates an internal RX switch that detects attempt to exit from applying less than 15lbs to the push pad, which causes this switch to start an irreversible alarm cycle. Key switch in device is capable of arming, disarming, or resetting the device; and indicator lamp determines status of the device.
   b) Provide devices capable of standard 15 second release delay and indefinite release delay as required by code, when tied into fire alarm system will release immediately when an alarm condition exists.
   c) Provide devices with all control inputs – door position input, external inhibit input, fire alarm input; auxiliary locking; nuisance alarm and internal horn; and, remote signaling output self-contained in the device assembly.

g. CVC
   1) Provide cable-actuated concealed vertical latch system in two-point for non-rated or fire rated wood doors up to a 90 minute rating and less bottom latch (LBL) configuration for non-rated or fire rated wood doors up to 20 minute rating. Vertical rods not permitted.
      a) Cable: Stainless steel with abrasive resistant coating. Conduit and core wire ends snap into latch and center slides without use of tools.
      b) Wood Door Prep: Maximum 1 inch x 1.1875 inch x 3.875 inches top latch pocket and 1 inch x 1.1875 inch x 5 inches bottom latch pocket which does not require the use of a metal wrap or edge for non-rated or fire rated wood doors up to a 45 minute rating.
      c) Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
      d) Top Latchbolt: Minimum 0.38 inch (10 mm) and greater than 90-degree engagement with strike to prevent door and frame separation under high static load.
      e) Bottom Latchbolt: Minimum of 0.44-inch (11 mm) engagement with strike.
      f) Product Cycle Life: 1,000,000 cycles.
      g) Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
      h) Latch release does not require separate trigger mechanism.
      i) Cable and latching system characteristics:
         i. Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
         ii. Connected to exit device at single point in steel and aluminum doors, and two points for top and bottom latches in wood doors.
         iii. Bottom latch height adjusted, from single point for steel and aluminum doors and two points for wood doors, after system is installed and connected to exit device, while door is hanging
         iv. Bottom latch position altered up and down minimum of 2 inches (51 mm) in steel and aluminum doors without additional adjustment. Bottom latch deadlocks in every adjustment position in wood doors.
         v. Top and bottom latches in steel and aluminum doors and top latch in wood doors may be removed while door is hanging.

2.09 ACCESS CONTROL READER

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage MT Series

B. Requirements:

1. Provide access control card readers manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications are not acceptable
2. Provide multi-technology contactless readers complying with ISO 14443.
3. Provide access control card readers capable of reading the following technologies:
   a. CSN - DESFire® CSN, HID iCLASS® CSN, Inside Contactless PicoTag® CSN, ST Microelectronics® CSN, Texas Instruments Tag-It®, CSN, Phillips I-Code® CSN
   b. 125 KHz proximity - Schlage® Proximity, HID® Proximity, GE/CASI® Proximity, AWID® Proximity, LenelProx®
   c. 13.56 MHz Smart card - Schlage smart cards using MIFARE Classic® EV1, Schlage smart cards using MIFARE Plus®, Schlage smart cards using MIFARE® DESFire® EV1, Schlage smart cards using MIFARE® DESFire® EV2/EV3

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.
   d. Low voltage DC, regulated and filtered.
   e. Polarized connector for distribution boards.
   f. Fused primary input.
   g. AC input and DC output monitoring circuit w/LED indicators.
   h. Cover mounted AC Input indication.
   i. Tested and certified to meet UL294.
   j. NEMA 1 enclosure.
   k. Hinged cover w/lock down screws.
   l. High voltage protective cover.

2.11 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product: **VERIFY WITH OWNER**
   a. FSIC Schlage

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.12 KEYING

A. Scheduled System: **VERIFY WITH OWNER**

1. New factory registered system:
   a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

2. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

3. Existing non-factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:
      1) Firm Name:
      2) Contact Person:
      3) Telephone:

B. Requirements:

1. Construction Keying:
   a. Temporary Construction Cylinder Keying.
      1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
         a) Split Key or Lost Ball Construction Keying System.
         b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
         c) 12 construction change (day) keys.
      2) Owner or Owner's Representative will void operation of temporary construction keys.
   b. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
      3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
   d. Identification:
      1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
      2) Identification stamping provisions must be approved by the Architect and Owner.
      3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
      4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
      5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
   e. Quantity: Furnish in the following quantities.
      1) Permanent Control Keys: 3.
      2) Master Keys: 6.
      3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
      4) Key Blanks: Quantity as determined in the keying meeting.

2.13 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

2. Acceptable Manufacturers:
   a. HPC
   b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
   b. Provide hinged-panel type cabinet for wall mounting.

2.14 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4040XP series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.15 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4600 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.

3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. No Substitute

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.19 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.20 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.

2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.21 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Rockwood
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.22 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Schlage

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.23 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum

10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.

2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.

2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

124661 OPT0352560 Version 1

Legend:
Link to catalog cut sheet
Electrified Opening

Hardware Group No. 01

For use on Door #(s):

A116	A117	A118	A119	A122	A123
A124	A183	A209	A210	A211	A212
A213	A214	A215	A216	B115	B135
B137	B139	B140	B219	B241A	C235A
C238A	C239A				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM SECURITY W/ INSIDE INDICATOR	ND78TD RHO IS-CRS		626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA @ HEAD & JAMBS		BK	ZER

Hardware Group No. 02

For use on Door #(s):

B207	B208	B220	C231B	C231C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 03

For use on Door #(s):
B144

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 6" X 16"		630	IVE
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 04

For use on Door #(s):
B132 B206

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	TIME OUT LOCK	ND45 RHO XN12-317		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 05

For use on Door #(s):
B103 B104 B105 B106 B108B B109A
B109B B110 B134 B226 C254

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND53TD RHO		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 06

For use on Door #(s):
B108A B113A B114 B201 C232

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP			652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO			626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
1	EA	ELECTRIC STRIKE	AS REQUIRED		✓	630	ADA
1	EA	SURFACE CLOSER	4040XP EDA			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	WALL STOP	WS406/407CCV			630	IVE
3	EA	SILENCER	SR64			GRY	IVE
1	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH		✓		SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.		✓	BLK	SCE
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.		✓	628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.		✓		VON

OPERATION:
DOOR IS NORMALLY LATCHED AND SECURED
PRESENTING VALID CREDENTIAL TEMPORARILY RELEASES STRIKE FOR ENTRY
FREE EGRESS AT ALL TIMES

Hardware Group No. 07

For use on Door #(s):
B138

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
1	EA	STOREROOM LOCK	ND80TD RHO			626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
1	EA	LOCK GUARD	LG14			630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)			AA	ZER
1	SET	GASKETING	429 @ HEAD & JAMBS			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS			A	ZER
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.		✓	628	SCE

Hardware Group No. 08

For use on Door #(s):
C256

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 09

For use on Door #(s):
A121 A205 B145 B217

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 10

For use on Door #(s):
C230A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	PANIC HARDWARE	98-NL-SNB		626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)		AA	ZER
1	SET	GASKETING	429 @ HEAD & JAMBS		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS		A	ZER
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE

Hardware Group No. 11

For use on Door #(s):
B245 B246

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	CLASSROOM SECURITY W/ INSIDE INDICATOR	ND78TD RHO IS-CRS		626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	GASKETING	870AA-S		AA	ZER
1	EA	DOOR BOTTOM	364AA		AA	ZER
1	EA	THRESHOLD	164A OR PER SILL DETAIL		A	ZER
1	EA	MOUNTING BRACKET	870SPB			ZER

Hardware Group No. 12

For use on Door #(s):

B107	B111	B112	B127	B129	B133
B222	B223	B242	C236	C237	C240
C255					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	EA	GASKETING	488SBK PSA @ HEAD & JAMBS		BK	ZER

Hardware Group No. 13

For use on Door #(s):
B131 B243 C251 C253

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
1	EA	STOREROOM LOCK	ND80TD RHO			626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
1	EA	SURFACE CLOSER	4040XP EDA			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	WALL STOP	WS406/407CCV			630	IVE
1	EA	GASKETING	488SBK PSA @ HEAD & JAMBS			BK	ZER

Hardware Group No. 14

For use on Door #(s):
C231D

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
1	EA	PANIC HARDWARE	98-NL-SNB			626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079			626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
1	EA	ELECTRIC STRIKE	AS REQUIRED			630	ADA
1	EA	SURFACE CLOSER	4040XP EDA			689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS			630	IVE
1	EA	FLOOR STOP	FS18S			BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)			AA	ZER
1	SET	GASKETING	429 @ HEAD & JAMBS			AA	ZER
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS			A	ZER
1	EA	VIEWER	U698			626	IVE
1	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH				SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.			BLK	SCE
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.			628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RELEASES ELECTRIC STRIKE TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. 15

For use on Door #(s):
C227B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	PANIC HARDWARE	98-NL-SNB		626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	ELECTRIC STRIKE	AS REQUIRED		630	ADA
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)		AA	ZER
1	SET	GASKETING	429 @ HEAD & JAMBS		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS		A	ZER
1	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH			SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.		BLK	SCE
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RELEASES ELECTRIC STRIKE TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. 16

For use on Door #(s):
B244

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	STOREROOM LOCK	ND80TD RHO		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 17

For use on Door #(s):
C227A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	98-L-NL-06-SNB		626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 18

For use on Door #(s):
C228A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 19

For use on Door #(s):
B126 B218 C225C C231A C233A C234

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	CONST LATCHING BOLT	FB53		630	IVE
1	EA	STOREROOM LOCK	ND80TD RHO		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
2	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 20

For use on Door #(s):
C225A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	CD-98-EO-SNB		626	VON
1	EA	PANIC HARDWARE	CD-98-L-06-SNB		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
3	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)		626	SCH
4	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	SURFACE CLOSER	4040XP SHCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	SILENCER	SR64		GRY	IVE

AUTHORIZED CREDENTIAL AT CARD READER TO RELEASE LEVER.
LEVER TO FAIL SAFE ON LOSS OF POWER AND/OR ACTIVATION OF FIRE ALARM SYSTEM, ALLOWING STAIRWELL RE-ENTRY.
DOOR USES SURFACE MOUNT DOOR POSITION SWITCH - DO NOT DRILL SWITCHES INTO FRAME.

Hardware Group No. 21

For use on Door #(s):
C225B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
2	EA	PANIC HARDWARE	LD-98-EO-SNB		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)		AA	ZER
1	SET	GASKETING	429 @ HEAD & JAMBS		AA	ZER
2	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS		A	ZER
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE

Hardware Group No. 22

For use on Door #(s):
C228B C229

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQUIRED		626	IVE
1	EA	STOREROOM LOCK	ND80TD RHO		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FLOOR STOP	FS18S		BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)		AA	ZER
1	SET	GASKETING	429 @ HEAD & JAMBS		AA	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	43STST		STST	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS		A	ZER
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE

Hardware Group No. AL01

For use on Door #(s):
C250B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC		626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS		A	ZER
2	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH			SCH
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.

INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL02

For use on Door #(s):
B203A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	PANIC HARDWARE	CD-98-NL-OP-110MD-SNB		626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)		626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL03

For use on Door #(s):
B202

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	CLASSROOM SECURITY W/ INSIDE INDICATOR	ND78TD RHO IS-CRS		626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL04

For use on Door #(s):
B101A B101B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
1	EA	INSTITUTION LOCK	ND82TD RHO			626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
1	EA	ELECTRIC STRIKE	AS REQUIRED			630	ADA
1	EA	OH STOP	100S ADJ			630	GLY
1	EA	SURFACE CLOSER	4040XP EDA			689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT			689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT			689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT			689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
1	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH				SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.			BLK	SCE
1	EA	REMOTE RELEASE BUTTON	BY DIVISION 28.			628	SCE
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.			628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.				VON

OPERATION: CARD IN / CARD OUT / REMOTE RELEASE
DOOR IS NORMALLY LATCHED AND SECURED
PRESENTING VALID CREDENTIAL OR PUSHING REMOTE RELEASE BUTTON TEMPORARILY RELEASES STRIKE FOR ENTRY AND EXIT

Hardware Group No. AL05

For use on Door #(s):
B241B C235B C238B C239B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
1	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC			626	VON
1	EA	FSIC RIM CYL. HOUSING	20-079			626	SCH
1	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10"			630-316	IVE
1	EA	OH STOP	100S ADJ			630	GLY
1	EA	SURFACE CLOSER	4040XP EDA			689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT			689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT			689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT			689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
1	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS			A	ZER
2	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH				SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.			BLK	SCE
1	EA	DOOR POSITION SWITCH	BY DIVISION 28.			628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL06

For use on Door #(s):
C250D

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	PUSH/PULL BAR	9190HD-10"		630	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL07

For use on Door #(s):
B203B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	CD-98-EO-SNB		626	VON
1	EA	PANIC HARDWARE	CD-98-NL-OP-110MD-SNB		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
3	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)		626	SCH
4	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
2	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
2	EA	WALL STOP	WS406/407CCV		630	IVE
2	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL08

For use on Door #(s):
A120A A120B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
2	EA	POWER TRANSFER	EPT10 CON		✓	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON-SNB 24 VDC		✓	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC		✓	626	VON
1	EA	MULLION STORAGE KIT	MT54			689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079			626	SCH
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)			626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"			630-316	IVE
2	EA	OH STOP	100S ADJ			630	GLY
2	EA	SURFACE CLOSER	4040XP EDA			689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT			689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 SRT			689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 SRT			689	LCN
2	EA	MULLION SEAL	8780NBK PSA			BK	ZER
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
2	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS			A	ZER
4	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH		✓		SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.		✓	BLK	SCE
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.		✓	628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.		✓		VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL09

For use on Door #(s):
A120C A120D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
2	EA	PUSH/PULL BAR	9190HD-10"		630	IVE
2	EA	OH STOP	100S ADJ		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. AL10

For use on Door #(s):
B141B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
2	EA	POWER TRANSFER	EPT10 CON			689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON-SNB 24 VDC			626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC			626	VON
1	EA	MULLION STORAGE KIT	MT54			689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079			626	SCH
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)			626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"			630-316	IVE
2	EA	OH STOP	100S ADJ			630	GLY
2	EA	SURFACE CLOSER	4040XP EDA			689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT			689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 SRT			689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 SRT			689	LCN
2	EA	MULLION SEAL	8780NBK PSA			BK	ZER
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
2	EA	DOOR SWEEP	39A			A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS			A	ZER
4	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH				SCH
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.			628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.				VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.

INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL11

For use on Door #(s):
B141A C250A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON-SNB 24 VDC		626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)		626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	OH STOP	100SE ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	SURF. AUTO OPERATOR	4642 TBWMS 120 VAC		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	EA	WEATHER RING	8310-801			LCN
1	EA	ACTUATOR, TOUCH	8310-818T		630	LCN
1	EA	MOUNT BOX	8310-819F / 819S AS REQUIRED			LCN
1	EA	ACTUATOR, TOUCH	8310-853T		630	LCN
1	EA	MOUNT BOX	8310-867S / 867F AS REQUIRED			LCN
2	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A - OR PER SILL DETAILS		A	ZER
4	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH			SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.		BLK	SCE
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER TO ALLOW ADA PUSH BUTTON TO ACTIVATE AUTO OPERATOR AND OPEN DOOR INSIDE ADA PUSH BUTTON ALWAYS ACTIVE.
SHOULD OWNER DESIRE,ACCESS CONTROL SYSTEM MAY HAVE LATCH RETRACTED DURING OPEN HOURS TO ALLOW FREE PUBLIC ENTRY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL12

For use on Door #(s):
B141D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON-SNB 24 VDC		626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079		626	SCH
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)		626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T		626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"		630-316	IVE
2	EA	OH STOP	100S ADJ		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
2	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			
4	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH			SCH
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.		628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.			VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.

INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL13

For use on Door #(s):
B141C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)			628	IVE
2	EA	POWER TRANSFER	EPT10 CON		✓	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB			689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-EO-CON-SNB 24 VDC		✓	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD-CON-SNB 24 VDC		✓	626	VON
1	EA	MULLION STORAGE KIT	MT54			689	VON
1	EA	FSIC RIM CYL. HOUSING	20-079			626	SCH
1	EA	FSIC MORTISE CYLINDER	26-094 (CAM & RING AS REQ'D)			626	SCH
2	EA	PERMANENT FSIC CORE	23-030 EV29 T			626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10"			630-316	IVE
1	EA	OH STOP	100S ADJ			630	GLY
1	EA	OH STOP	100SE ADJ			630	GLY
1	EA	SURFACE CLOSER	4040XP EDA			689	LCN
1	EA	SURF. AUTO OPERATOR	4642 TBWMS 120 VAC		✓	689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT			689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT			689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT			689	LCN
1	EA	ACTUATOR, TOUCH	8310-818T		✓	630	LCN
1	EA	MOUNT BOX	8310-819F / 819S AS REQUIRED				LCN
1	EA	ACTUATOR, TOUCH	8310-853T		✓	630	LCN
1	EA	MOUNT BOX	8310-867S / 867F AS REQUIRED				LCN
2	EA	MULLION SEAL	8780NBK PSA			BK	ZER
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER				
4	EA	WIRE HARNESS	CON-XXXP (LENGTH AS REQUIRED) VERIFY LENGTH		✓		SCH
1	EA	MULTITECH READER	MT11 / MT15 BY DIVISION 28.		✓	BLK	SCE
2	EA	DOOR POSITION SWITCH	BY DIVISION 28.		✓	628	SCE
1	EA	POWER / LOW VOLTAGE POWER	BY DIVISION 28.		✓		VON

DOOR IS NORMALLY LOCKED. RESTRICTING ENTRY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER MOMENTARILY RETRACTS LATCH TO ALLOW ENTRY OR BY KEY.
AUTHORIZED CREDENTIAL AT OUTSIDE CARD READER TO ALLOW ADA PUSH BUTTON TO ACTIVATE AUTO OPERATOR AND OPEN DOOR INSIDE ADA PUSH BUTTON ALWAYS ACTIVE.
SHOULD OWNER DESIRE,ACCESS CONTROL SYSTEM MAY HAVE LATCH RETRACTED DURING OPEN HOURS TO ALLOW FREE PUBLIC ENTRY.
INSIDE TOUCHBAR ALWAYS ALLOWS EGRESS.

Hardware Group No. AL14

For use on Door #(s):
C250C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	027XY / 112XY (EPT AS REQUIRED)		628	IVE
2	EA	PUSH/PULL BAR	9190HD-10"		630	IVE
1	EA	OH STOP	100S ADJ		630	GLY
1	EA	OH STOP	100SE ADJ		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	SURF. AUTO OPERATOR	4642 TBWMS 120 VAC		689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRT		689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 SRT		689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 SRT		689	LCN
1	EA	ACTUATOR, TOUCH	8310-818T		630	LCN
1	EA	MOUNT BOX	8310-819F / 819S AS REQUIRED			LCN
1	EA	ACTUATOR, TOUCH	8310-853T		630	LCN
1	EA	MOUNT BOX	8310-867S / 867F AS REQUIRED			LCN
1	SET	SEALS	BY DOOR / FRAME MANUFACTURER			

Hardware Group No. OH01

For use on Door #(s):
C230B C233B C252E

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	EA	NOTE	HARDWARE BY ROLLUP DOOR MANUFACTURER		

Door Numbers	HwSet#
A116	01
A117	01
A118	01
A119	01
A120A	AL08
A120B	AL08
A120C	AL09
A120D	AL09
A121	09
A122	01
A123	01
A124	01
A183	01
A205	09
A209	01
A210	01
A211	01
A212	01
A213	01
A214	01
A215	01
A216	01
B101A	AL04
B101B	AL04
B103	05
B104	05
B105	05
B106	05
B107	12
B108A	06
B108B	05
B109A	05
B109B	05
B110	05
B111	12
B112	12
B113A	06
B114	06
B115	01
B126	19
B127	12
B129	12
B131	13
B132	04
B133	12
B134	05
B135	01

Door Numbers	HwSet#
B137	01
B138	07
B139	01
B140	01
B141A	AL11
B141B	AL10
B141C	AL13
B141D	AL12
B144	03
B145	09
B201	06
B202	AL03
B203A	AL02
B203B	AL07
B206	04
B207	02
B208	02
B217	09
B218	19
B219	01
B220	02
B222	12
B223	12
B226	05
B241A	01
B241B	AL05
B242	12
B243	13
B244	16
B245	11
B246	11
C225A	20
C225B	21
C225C	19
C227A	17
C227B	15
C228A	18
C228B	22
C229	22
C230A	10
C230B	OH01
C231A	19
C231B	02
C231C	02
C231D	14
C232	06
C233A	19

Door Numbers	HwSet#
C233B	OH01
C234	19
C235A	01
C235B	AL05
C236	12
C237	12
C238A	01
C238B	AL05
C239A	01
C239B	AL05
C240	12
C250A	AL11
C250B	AL01
C250C	AL14
C250D	AL06
C251	13
C252E	OH01
C253	13
C254	05
C255	12
C256	08

END OF SECTION

SECTION 08 8000

GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Glazing work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Insulating glass units.
C. Spandrel glass units
D. Glazing units.
E. Glazing shall withstand normal thermal movement, wind and impact loads (where applicable) without failure.
F. Glazing compounds and access.
G. Unless specifically indicated on the drawings, glazing shall comply with ICC (IBC) - International Building Code 2018 for locations of tempered glazing.
H. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealants for other than glazing purposes.
B. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors, borrowed lites, and transoms.
C. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
D. Section 08 4313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
E. Section 08 4413 - Glazed Aluminum Curtain Wall: Glazing provided as part of wall assembly.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
M. GANA (GM) - GANA Glazing Manual; 2008.

N. GANA (SM) - GANA Sealant Manual; 2008.
O. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
P. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2020.
Q. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2020.
R. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit two samples 12 by 12 inch in sizeof glass units, showing coloration and design.
E. Manufacturer's Certificate: Certify that glass and glazing products meets or exceeds specified requirements.
    1. Refer to Sections 08 4313 and 08 4413 for assembly thermal performance compliance and certification.
F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods. Maintain one copy on site.
B. Provide glass obtained from a single source.
C. Provide compatibilty and adhesion testing for glazing tapes, gaskets, sealants and other accessories. Prior test reports may be acceptable in lieu of testing.
D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
E. Installer Qualifications: Company specializing in performing the work of this section with minimum five yearsdocumented experience.
F. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

A. See Section 01 4300 - Quality Assurance for additional requirements.
B. Provide on-site glazing mock-up with the specified glazing components.
C. Locate where directed.
D. Mock-ups may remain as part of the Work, if undisturbed at time of substantial completion at the discretion of the Architect.

1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 50 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.
D. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
    1. AGC Glass North America, Inc: www.agcglass.com.
    2. Cardinal Glass Industries: www.cardinalcorp.com.
    3. Guardian Glass, LLC: www.guardianglass.com.
    4. Pilkington North America Inc: www.pilkington.com/na.
    5. Vitro Architectural Glass: www.vitroglazings.com.
    6. Substitutions: See Section 01 6000 - Product Requirements.
B. Laminated Glass Manufacturers:
    1. Cardinal Glass Industries: www.cardinalcorp.com.
    2. Viracon, Architectural Glass segment of Apogee Enterprises, Inc: www.viracon.com.
    3. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com.
    4. Substitutions: See Section 01 6000 - Product Requirements.
C. Fire-Protection-Rated Glass: Provide products as required to achieve indicated fire-rating period.
    1. Fabricators:
        a. GGI - General Glass International: www.generalglass.com.
    2. Manufacturers:
        a. AGC Glass North America, Inc.: www.agc-yourglass.com.
        b. SAFTIFIRST, a division of O'Keeffe's Inc.: www.safti.com.
        c. SCHOTT North America, Inc.: www.us.schott.com.
        d. Technical Glass Products: www.fireglass.com.
        e. Vetrotech North America; Contraflam 45: www.vetrotechusa.com.
    3. Substitutions: Refer to Section 01 6000 - Product Requirements.
D. Etched Glass Manufacturers:
    1. AGC Glass North America, Inc; Matelux Bird Friendly Acid-Etched Glass: www.agcglass.com.
    2. GGI - General Glass International; Satin Etched: www.generalglass.com.
    3. Walker Glass Company Ltd; Walker Textures - Acid-Etched Glass: www.walkerglass.com.
    4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7.
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/200 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:
   2. To utilize inner pane of multiple pane insulating glass units for continuity of vapor retarder and/or air barrier seal.
   3. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

D. Refer to Sections 08 4313 and/or 08 4413 for Assembly Thermal Performance Compliance and Certification.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Impact Resistant Safety Glass: Complies with ANSI Z97.1 - Class B, or 16 CFR 1201 - Category I criteria.
   6. Sputter-Coated Float Glass: ASTM C1376, float glass with metallic oxide or nitride coating deposited by vacuum deposition process following primary glass product manufacturer.
   7. Ceramic-Coated Vision Glass: Float glass with silk-screened ceramic enamel application, per ASTM C 1048, Condition B, Type I, Quality-Q3, and Specification No. 95-1-31 in GANA 'Engineering Standards Manual.'
   8. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3 and GANA 'Engineering Standards Manual' 66-9-20 Specification for Heat-Strengthened or Fully Tempered Ceramic Enameled Spandrel Glass for Use in Building Window/Curtain Walls and Other Architectural Applications.

9. Coated Spandrel Float Glass: Float glass complying with ASTM C 1048, GANA 'Engineering Standards Manual' 89-1-6 Specification for Environmental Durability of Fully Tempered or Heat-Strengthened Spandrel Glass with Applied Opacifier and other requirements specified, with manufacturer's standard opacifier material on coated second surface of lites.
10. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Decorative Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class A and 16 CFR 1201 - Category II impact test requirements.
2. Plastic Interlayer: 0.045 inch (1.14 mm) thick, minimum.
3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.
4. Manufacturers:
   a. Dupont; Product - "SentryGlas Expressions": www.sentryglas.dupont.com.
   b. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Fire-Protection-Rated Glazing:
1. IBC Fire Protection Rating: As indicated on drawings.
2. Safety Certification: 16 CFR 1201 Category II.
3. Products:
   a. SAFTI FIRST, a division of O'Keeffe's Inc; SuperLite X-90: www.safti.com.
   b. SCHOTT North America Inc; Pyran Platinum L: www.us.schott.com.
   c. Vetrotech Saint-Gobain North America; Keralite L: www.vetrotechusa.com.
   d. Vetrotech Saint-Gobain North America; Contraflam: www.vetrotechusa.com.
   e. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.04 SEALED INSULATING GLASS UNITS

A. Manufacturers:
1. Any of the manufacturers specified for float glass.
2. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
3. AGC Glass North America, Inc: www.agcglass.com.
4. Northwestern Industries, Inc. www.nwiglass.com.
5. Viracon, Apogee Enterprises, Inc: www.viracon.com.
6. Oldcastle BuildingEnvelope. www.obe.com.
7. Substitutions: See Section 01 6000 - Product Requirements.

B. Sealed Insulating Glass Units: Types as indicated.
1. Locations: Exterior, except as otherwise indicated.
2. Durability: Certified by an independent testing agency to comply with ASTM E2190.
3. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
4. Warm-Edge Spacers: Viracon Thermal Spacer (VTS).
   a. Spacer Width: As required for specified insulating glass unit.
   b. Spacer Height: 0.27 inch.
   c. Manufacturers:
      1) Viracon, Apogee Enterprises, Inc: www.viracon.com.
      2) Technoform Glass Insulation; TGI-Spacer: www.glassinsulation.us.
      3) Substitutions: See Section 01 6000 - Product Requirements.
5. Spacer Color: Black.
6. Edge Seal:

a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone sealant as secondary seal applied around perimeter.

7. Color: Black.
8. Purge interpane space with dry air, hermetically sealed.

2.05 GLAZING TYPES

A. Type G1 - Clear Double Glazed Solarban 70.
   1. Conformance: ASTM E 2190.
   2. Outdoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass.
      a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
      b. Glass Thickness: 6 mm (1/4 inch).
      c. Coating: Solarban 70 on Surface number 2.
         1) Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
      d. Heat-Treatment:
         1) Heat-strengthened, ASTM C 1048, Kind HS.
   3. Interspace Content: Argon or air 1/2 inch (12.7 mm).
   4. Indoor Lite: Clear float glass as manufactured by Vitro Architectural Glass.
      a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
      b. Heat-Treatment:
         1) Heat-strengthened, ASTM C 1048, Kind HS.
      c. Glass Thickness: 6 mm (1/4 inch).
   5. Total Thickness: 1 inch (25 mm).
   6. Performance Requirements:
      a. Visible Light Transmittance: 64 percent minimum.
      b. Winter Nighttime U-Factor: 0.28 (Btu/hr*ft2*°F) maximum.
      c. Summer daytime U-Factor: 0.26 (Btu/hr*ft2*°F) maximum.
      d. Shading Coefficient: 0.32 maximum.
      e. Solar Heat Gain Coefficient: 0.27 maximum.
      f. Outdoor Visible Light Reflectance: 12 percent maximum.

B. Type G2 - 100 percent Ceramic Frit Clear Solarban 70 - Double Glazed Solar Control Spandrel.
   1. Conformance: ASTM C 1048, Condition B, Type I, Quality-Q3 and GANA Engineering Standards Manual GANA 66-9-20 Specification for Heat-Strengthened or Fully Tempered Ceramic Enameled Spandrel Glass for Use in Building Window/Curtain Walls and Other Architectural Application.
   2. Outdoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass
      a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
      b. Glass Thickness: 6 mm (1/4 inch).
      c. Coating: Solarban 70 on Surface number 2.
         1) Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
      d. Heat-Treatment:
         1) Heat-strengthened, ASTM C 1048, Kind HS.
         2) Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201.
   3. Interspace Content: Argon or air 1/2 inch (12.7 mm).
   4. Indoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass.
      a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
      b. Glass Thickness: 6mm (1/4 inch).
      c. Heat-Treatment:
         1) Heat-strengthened, ASTM C 1048, Kind HS.

2) Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201.

d. Coating Type: Ceramic Frit, 100 percent coverage.
1) Color: Standard Color to be selected by Architect.

e. Spandrel Coating Surface: 4.

5. Total Thickness: 1 inch (25 mm).
6. Performance Requirements:
a. Visible Light Transmittance: 61 percent minimum.
b. Winter Nighttime U-Factor: 0.28 (Btu/hr*ft2*°F) maximum.
c. Summer daytime U-Factor: 0.26 (Btu/hr*ft2*°F) maximum.
d. Shading Coefficient: 0.31 maximum.
e. Solar Heat Gain Coefficient: 0.27 maximum.
f. Outdoor Visible Light Reflectance: 12 percent maximum.
7. Both lites to be fully tempered where indicated on Drawings.

C. Type G3 - Clear Double Glazed Solarban 70.
1. Conformance: ASTM E 2190.
2. Outdoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass.
a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
b. Glass Thickness: 6 mm (1/4 inch).
c. Coating: Solarban 70 on Surface number 2.
1) Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.

d. Heat-Treatment:
1) Heat-strengthened, ASTM C 1048, Kind HS.

3. Interspace Content: Argon or air 1/2 inch (12.7 mm).
4. Indoor Lite: Clear float glass as manufactured by Vitro Architectural Glass.
a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
b. Heat-Treatment:
1) Heat-strengthened, ASTM C 1048, Kind HS.

c. Glass Thickness: 6 mm (1/4 inch).
5. Total Thickness: 1 inch (25 mm).
6. Performance Requirements:
a. Visible Light Transmittance: 64 percent minimum.
b. Winter Nighttime U-Factor: 0.28 (Btu/hr*ft2*°F) maximum.
c. Summer daytime U-Factor: 0.26 (Btu/hr*ft2*°F) maximum.
d. Shading Coefficient: 0.32 maximum.
e. Solar Heat Gain Coefficient: 0.27 maximum.
f. Outdoor Visible Light Reflectance: 12 percent maximum.
7. Safety Film: Safe Haven Defense US, LLC, located at 22849 N. 19th Ave. Suite 100; Phoenix, AZ 85027; Tel: 303-263-7259; Email: request info; Web: https://safehavendefense.com.
a. Safe Haven Defense: SW600RC - Glazing Riot Resistant Laminate Film as manufactured by Safe Haven Defense. Offers protection for glass breakage due to forced entry such as burglaries, hurricanes, and blast. Hinders entry into property.
1) Standards Compliance:
(a) Building Glaze Materials: Per ANSI Z97.1.
(b) CPSC 16 CFR 1201: Impact Test.
(c) ASTM E1886: Hurricane Wind.
(d) GSA Explosive Test: GSA TS01-2003.
(e) BMAG: Level 1- Blast Mitigation.
(f) UL972 / ULC 332: Burglary Protection.
(g) ASTM F3561: Forced Entry after Shooter Attack.

2) Performance Requirements:
   (a) Thickness (1 layer): 35 mil (0.89 mm).
   (b) Estimated 15-30 minutes of resistance against common burglar tools.
   (c) Break Strength: 1100 psi (7584 kPa).
   (d) Tensile Strength: 34,000 psi (234,420 kPa).
   (e) Peel Strength: 6 psi (41 kPa).
   (f) Total Solar Energy Rejection: 20 percent.
   (g) IR Rejection: 59 percent.
   (h) UV Rejection: 99 percent.

D. Type G4 - Single Vision Glazing:
   1. Type: Annealed float glass; fully tempered float glass as indicated on drawings.
   2. Tint: Clear.
   3. Thickness: 1/4 inch (6 mm).
   4. Safety Film: Safe Haven Defense US, LLC, located at 22849 N. 19th Ave. Suite 100; Phoenix, AZ 85027; Tel: 303-263-7259; Email: request info; Web: https://safehavendefense.com.
      a. Safe Haven Defense: SW600RC - Glazing Riot Resistant Laminate Film as manufactured by Safe Haven Defense. Offers protection for glass breakage due to forced entry such as burglaries, hurricanes, and blast. Hinders entry into property.
         1) Standards Compliance:
            (a) Building Glaze Materials: Per ANSI Z97.1.
            (b) CPSC 16 CFR 1201: Impact Test.
            (c) ASTM E1886: Hurricane Wind.
            (d) GSA Explosive Test: GSA TS01-2003.
            (e) BMAG: Level 1- Blast Mitigation.
            (f) UL972 / ULC 332: Burglary Protection.
            (g) ASTM F3561: Forced Entry after Shooter Attack.
         2) Performance Requirements:
            (a) Thickness (1 layer): 35 mil (0.89 mm).
            (b) Estimated 15-30 minutes of resistance against common burglar tools.
            (c) Break Strength: 1100 psi (7584 kPa).
            (d) Tensile Strength: 34,000 psi (234,420 kPa).
            (e) Peel Strength: 6 psi (41 kPa).
            (f) Total Solar Energy Rejection: 20 percent.
            (g) IR Rejection: 59 percent.
            (h) UV Rejection: 99 percent.

E. Type G5 - Single Vision Glazing:
   1. Type: Annealed float glass; fully tempered float glass as indicated on drawings.
   2. Tint: Clear.
   3. Thickness: 1/4 inch (6 mm).

F. Type G6 - Single/ Etched
   1. Type: Annealed float glass.
   2. Coating: 100 percent Acid Etch on surface number 2.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6 mm).

G. Type G7 - Fire Protective Rated Glass 100 sq in or less.
   1. Thickness: 3/16 inch.
   2. Rating: 20 - 90 minute.
   3. IBC Fire Rated Marking: D-H-90.
   4. Safety Glazing Certification: 16 CFR 1201 Category II.

5. Provide permanent markings on fire-protectve-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
6. Basis of Design: Keralite by Vetrotech.
7. Substitutions: Refer to Section 01 6000 - Product Requirements.

H. Type G8 - Sealed Insulating Glass Units: Vision/Sound glazing.
1. Between-lite space filled with Argon or air 1/2 inch (12.7 mm).
2. Outboard Lite: Annealed float glass at band room.
   a. Coating: None.
   b. Tint: Clear.
3. Inboard Lite: Annealed float glass.
   a. Tint: Clear.
4. Total Thickness: 1 inch (25 mm).

I. Type T - Sealed Insulating Glass Units: Safety glazing.
1. Applications: Provide this type of glazing in the following locations:
   a. Glazed lites in exterior doors.
   b. Glazed sidelights and panels next to doors.
   c. Other locations required by applicable federal, state, and local codes and regulations.
   d. Other locations indicated on drawings.
2. Type: Same as Type G1, G2, G3, G4, G5, G6, G7, G8 except use fully tempered float glass for both outboard and inboard lites.
3. Unless specifically indicated on the drawings, glazing shall comply with ICC (IBC) - International Building Code; current editiion for loactions of tempered glazing.

2.06 GLAZING ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option I. Minimum 3 inches long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compoundwith integral resilient spacer rod applicable to application indicated; 10 to 15 cured Shore A durometer hardness; coiled on release paper; black color.
1. Manufacturers:
   a. Pecora Corporation: www.pecora.com.
   b. Tremco Global Sealants: www.tremcosealants.com.
   c. Saint-Gobain Performance Plastics: www.plastics.saint-gobain.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; color as selected by Architect.
1. Gaskets to be one piece with factory molded corners.

E. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

C. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

3.04 INSTALLATION - INTERIOR DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.
B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
E. Place glazing tape on free perimeter of glazing in same manner described above.
F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
G. Carefully trim protruding tape with knife.

3.05 INSTALLATION - EXTERIOR WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
B. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
D. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/8 inch below sight lines.
    1. Place glazing tape on glazing pane of unit with tape flush with sight line.
G. Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
H. Apply cap bead of sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
B. Remove nonpermanent labels immediately after glazing installation is complete.
C. Clean glass and adjacent surfaces after sealants are fully cured.
D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 8000

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SECTION 08 8200

DISPLAY CASE ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Display Case Assembly work as indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Built-in display case assemblies.
   1. Display Case Doors.
   2. Tackable Display Case Lining.
   3. Display Case Shelving System.
   4. Display Case Lighting.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing.
B. Section 07 9200 - Joint Sealants.
C. Section 08 8000 - Glazing: Glazing requirements.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
D. GANA (GM) - GANA Glazing Manual; 2008.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate work of related trades, including Reinforced Unit Masonry, Rough Carpentry, Finish Carpentry, Architectural Casework, Gypsum Board Assemblies, and Glazing, to prepare openings and install built-in display case assemblies.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Manufacturer's standard details and fabrication method.
   2. Data on finishes, hardware, and accessories.
   3. Recommendations for maintenance and cleaning of finished surfaces.
   4. Installation methods.
C. Shop drawings for each Display Case Assembly are required, including:
   1. Layout and installation details.
   2. Elevations at 1/4-inch scale.
   3. Anchorage and reinforcement.
   4. Glazing details.
D. Shop Drawings: Include plans, elevations, and details showing type and thickness of glass, glazing, anchoring, trim, and accessories.

E. Samples:
   1. Two samples each, 12 inches (300 mm) in length, showing actual material and finish of all metal components
   2. Two samples each, 12 inches (150 mm) square in size, showing actual material and finish of glass and tackboard system, including edge conditions.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage an experienced installer who has completed installations of Display Case Assemblies similar in design and extent to those required for the project and whose work has resulted in construction with a record of success in service performance and has a minimum of 5 years of documented experience.

B. Display Case Door System Manufacturer Qualifications: Provide Display Case Doors produced by a firm experienced in manufacturing Display Case Door Systems that are similar to those indicated for this project and that have a record of success in service performance.
   1. Single source responsibility: Obtain Display Case Door Systems from a single manufacturer to ensure full compatibility and warranty of parts.

C. Shelving System Manufacturer Qualifications: Manufacturer specializing in designing and fabricating aluminum display systems, support brackets, and other architectural specialties with 5 years minimum successful experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site and store in protective cartons until openings are ready for installation.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Field Measurements: Check opening by accurate field measurement before fabrication.
   1. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work and possible damage to the finished product.

1.09 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 DISPLAY CASE SYSTEM

A. Approved Manufacturers:
   1. Stylmark Showcases: www.stylmark.com.
   2. C.R. Laurence Co, Inc/Blumcraft: www.crlaurence.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Display Case Doors:
   1. Top Channel (110008): 1 3/16 inch by 13/16 inch (30 m by 20.6 mm) aluminum.
   2. Door Guides (419030): Vinyl door guide.
   3. Top Moulding (110024): 7/16 inch by 3/8 inch (11 mm by 10 mm) aluminum.
   4. Jambs (110061): 1 5/16 inch by 1/2 inch (33 mm by 13 mm) aluminum.
   5. Door Bumpers (221015): Clear bumper.

6. Track (110178): 1 3/16 inch by 1/2 inch (30 m by 13 mm) aluminum security track.
7. Shoe (110140) with End Caps: 7/16 inch by 1 1/2 inch (11 mm by 38 mm) heavy duty aluminum shoe.
8. Retainers (410381): 3/4 inch (19 mm) security door retainer.
9. Wheel Assembly (510041): Heavy duty wheel assembly.
10. Lock (510808): Chrome K-41 plunger lock assembly.
11. Glazing Tape (119004): 1/4 inch (6 mm) black vinyl glazing tape.

C. Glass: Provide flat, fully tempered glass for doors.
1. Safety Glass Standards: Tempered glass components that comply with ANSI Z97.1 and testing requirements of CPSC 16 CFR 1201 Category II. Comply with ASTM C1048 , Kind FT (fully tempered), Condition A (uncoated), Type I (transparent, flat), Class 1 (clear), Quality q3 glazing.
2. Thickness: 3/8 inch (10 mm).
3. Edge treatment: Provide bright flat polished edges for all exposed edges of glass with routed finger pulls.
4. Tint: Clear
5. All glass fabrication to be completed before tempering.
6. Visible tong marks or tong mark distortions are not permitted in tempered glass.

D. Fabrication:
1. General: Fabricate Display Case Door components to designs and sizes indicated on drawings (Field verify all opening dimensions).
   a. Do not permit cutting, drilling or other alterations to glass after tempering.
   b. Fabricate work to accommodate required hardware, anchors, reinforcement, and accessory items.
2. Prefabrication: Complete fabrication, assembly, finishing, hardware application and other work to the greatest extent possible before shipment to the project site. Disassemble components only as necessary for shipment and installation.
3. Continuity: Maintain accurate relation of planes and angles with hairline fit of contracting members.

E. Metal Finishes: Satin Clear Anodized.

2.02 DISPLAY CASE SHELVING SYSTEM (CABLE)

A. Basis of Design Manufacturer:
1. InWest Manufacturing; Suspended Glass Cable Shelving System: 801-808-7434
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Shelving System: Top and bottom cable tensioners with 1/8-inch stainless steel cable including 3/8-inch adjustable shelf support brackets.
1. Provide complete shelving system as detailed on Drawings.

C. Glass Shelves: Provide flat, fully tempered glass.
1. Safety Glass Standards: Tempered glass components that comply with ANSI Z97.1 and testing requirements of CPSC 16 CFR 1201 Category II. Comply with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I (transparent, flat), Class 1 (clear), Quality q3 glazing.
2. Thickness: 1/4 inch (6 mm).
3. Edge treatment: Provide bright flat polished edges for all edges of glass.
4. Tint: Clear

2.03 TACKABLE DISPLAY CASE LINING

A. Panel Backing: Plywood, PS 1, Grade B-B, 3/4 inch (19 mm) thick.

B. Panels:
1. Core Material: 1/2 inch (12.7 mm) Class "A" rated tackable fiberboard.

2. Facing Material: Type II, Class "A" vinyl, 21 oz/linear yd, with osnaburg backing and Teflon coating.
   a. Pattern: Merrifield V200 by Koroseal/RJF International.
   b. Color: As selected by Architect.
3. Size: As detailed on Drawings.
4. Profile: Square.
5. Intermediate Joints: Butt joints square.
6. Perimeter Trim: 5/8 inch (16 mm) aluminum "J" Trim.

2.04 DISPLAY CASE LIGHTING (ALL DISPLAY CASES)

A. Provided and installed by section 88200, connected to main power by Electrical Division.
   1. TRULUX Standard grade tape light with difused lense to block direct eye contact.
   2. Basic TRULUX dimmer switch control system.
   3. LED 30W driver.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are acceptable.
B. Do not begin installation until substrates and openings have been properly prepared.
C. If substrate preparation is the responsibility of another installer or trade, notify Architect of unsatisfactory or detrimental conditions before proceeding.

3.02 INSTALLATION

A. Install in accordance with manufacturer's printed instructions and approved shop drawings.
B. Install components plumb and level, in proper plane, free from warp and twist.
C. Install glass and accessories in accordance with GANA (GM) Glazing Manual.

3.03 ADJUSTING

A. Adjust doors and hardware to provide an acceptable fit at meeting points and at weatherstripping for smooth operation and dust tight closure.
B. Hardware: Adjust operating hardware to ensure proper operation.

3.04 CLEANING

A. After installation clean metal and glass surfaces to remove dust, loose fibers, fingerprints, adhesives, and other foreign materials.

3.05 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace products damaged before Substantial Completion.

END OF SECTION 08 8200

SECTION 09 0561

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Floor Preparation work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Resilient flooring.
   2. Broadloom carpet.
   3. Ceramic tile.
   4. Quarry tile.
   5. Entrance flooring.

B. Preparation of new concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all remediation of concrete floor slabs as required.

E. Patching compound.

F. Remedial floor coatings.

G. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 01 4300 - Quality Assurance: Additional requirements relating to testing agencies and testing.

B. Section 03 3000 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.
   2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
   3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
   4. Manufacturer's installation instructions.
   5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

C. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Include certification of accuracy by authorized official of testing agency.
   8. Submit report to Architect.
   9. Submit report not more than two business days after conclusion of testing.

D. Adhesive Bond and Compatibility Test Report.

1.06 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.
   1. Contractor shall schedule testing.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.08 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

1.09 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
    1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
    2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for concrete slab relative humidity moisture up to 95 percent; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
    1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
    2. Use product recommended by testing agency.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.
B. Perform following operations in the order indicated:
    1. Preliminary cleaning.
    2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
    3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
    4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
    5. Specified remediation, if required.
    6. Patching, smoothing, and leveling, as required.
    7. Other preparation specified.

8. Adhesive bond and compatibility test.
9. Protection.

3.02 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
C. Test in accordance with ASTM F1869 and as follows.
D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
F. Report: Report the information required by the test method.

3.03 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
    1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
    2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
    3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.04 PH TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
B. Note: This procedure is the equivalent of that described in ASTM F710; repeated here for the Contractor's convenience.
C. Use a wide range pH paper, its associated chart, and distilled or deionized water.
D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the pH paper into the water, remove it, and compare immediately to chart to determine pH reading.
E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of limits, perform remediation if any test value is over 10.

3.05 PREPARATION

A. See individual floor covering section(s) for additional requirements.
B. Comply with requirements and recommendations of floor covering manufacturer.
C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.06 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.07 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

END OF SECTION 09 0561

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SECTION 09 2116

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Gypsum Board Assembly work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Performance criteria for gypsum board assemblies.
C. Metal stud wall framing.
D. Tile backing board.
E. Gypsum shaft liner.
F. Impact resistant wallboard.
G. Acoustic sealant.
H. Joint treatment and accessories.
I. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Exterior wind-load-bearing metal stud framing.
B. Section 06 1000 - Rough Carpentry: Miscellaneous wood blocking products.
C. Section 07 2100 - Thermal Insulation: Acoustic insulation.
D. Section 07 2500 - Membrane Weather Barriers: Water-resistive barrier over sheathing.
E. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.
F. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
G. Section 09 3000 - Tiling: Tile backing board.
H. Section 10 2800 Toilet Accessories: Areas needing blocking

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2012.
B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
C. ANSI A118.9>ANSI A108/A118/A136.1 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2010).
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
F. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.

J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
M. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
N. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2021.
O. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
P. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.
Q. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
S. ASTM E413 - Classification for Rating Sound Insulation; 2016.
T. GA-214 - Levels of Finish for Gypsum Panel Products; 2021.
U. GA-216 - Application and Finishing of Gypsum Panel Products; 2016, with Errata.
V. GA-236 - Joint Treatment Under Extreme Weather Condition; 2013.
W. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
X. UL (FRD) - Fire Resistance Directory; Current Edition.
Y. UL (FRD) - Fire Resistance Directory; Current Edition.
Z. UL U419 - Fire Resistance Ratings; 2016.
AA. UL V438 - Fire Resistance Ratings; 2014.
BB. UL V450 - Fire Rated System Design; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
C. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.
B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 MOCK-UP

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
    1. Install Mockups for the following:
        a. Each level of gypsum board finish indicated for the use in exposed locations.
        b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.

1.07 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.
B. Acoustic Interior Partitions: Provide completed assemblies with the following characteristics:
   1. All interior walls with insulation are to be treated as an Acoustic Assembly.
   2. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
C. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
   1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
   2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
   2. Marino: www.marinoware.com.
   3. Phillips Manufacturing Co: www.phillipsmfg.com
   4. SCAFCO Corporation: www.scafco.com/#\.
   5. Cemco Steel: www.cemcosteel.com.
   6. CertainTeed Corporation: www.certainteed.com.
   7. Any of the Board Manufacturers listed below
   8. Substitutions: See Section 01 6000 - Product Requirements.
B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.
   1. Channel Bridging and Bracing: U-Channel Assembly; Base metal thickness of 0.05 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges.
   2. Flat Strap and Backing Plate: Sheet for blocking and bracing in length and width indicated:
      a. Galvanized sheet steel: 6 inches by continuous by 18 ga minimum.
   3. Galvanized termination angle:
      a. 2 inch by 2 inch angle to close gap between wall and floor.
   4. Deflection and Firestop Track:
      a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
C. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Galvanize metal studs per ASTM C645
      a. G60 Exterior Walls.
      b. G60 Interior Wet Areas.
      c. G40 Interior Dry Areas.
      d. A40 galvannealed products are unacceptable per ASTM C645

2. Studs: 33 mil minumum (unless noted otherwise on drawings), "C" shaped with flat or formed webs .
3. Runners: 33 mil (unless noted otherwise on drawings), U shaped, sized to match studs.
4. Slotted Deflection Track:
   a. Manufacturer's deep-leg, U-shaped steel track; punched with vertical slots in both legs.
   b. Flange width (leg depth) and thickness as noted on Contract Drawings.
5. Ceiling Channels: C-shaped.
6. Furring: Hat-shaped sections, minimum depth of 7/8 inch, refer to drawings for thickness
7. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 4000.
8. Channel Bridging and Bracing: U-Channel Assembly; Base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges.
9. Flat Strap and Backing Plate: Sheet for blocking and bracing in length and width indicated:
   a. Galvanized sheet steel: 6 inches by continous by 18 ga minimum.
10. Galvanized termination angle:
    a. 2 inch by 2 inch angle to close gap between wall and floor.
11. Deflection and Firestop Track:
    a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.

D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   a. Products:
2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with hot dipped galvanized coating to match wall stud coating.
3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
4. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
   a. Products:
      1) Same manufacturer as other framing materials.

E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
1. Products:
   a. ClarkDietrich; BlazeFrame Firestop Deflection Track: www.clarkdietrich.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company: www.americangypsum.com.
2. CertainTeed Corporation: www.certainteed.com.
3. Continental Building Products; ____: www.continental-bp.com.
4. Georgia-Pacific Gypsum: www.gpgypsum.com.
5. Continental Building Products: www.continental-bp.com.
6. National Gypsum Company: www.nationalgypsum.com.
7. PABCO Gypsum: www.pabcogypsum.com.
8. USG Corporation: www.usg.com.
9. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch typical, refer to drawings for other thicknesses required.
      b. Ceilings: 5/8 inch typical, refer to drawings for other thicknesses required.
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Impact Resistant Wallboard:
   1. Application: As indicated on drawings.
   2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   3. Indentation: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   5. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   6. Paper-Faced Type: Gypsum wallboard as defined in ASTM C1396/C1396M.
   7. Type: Fire resistance rated Type X, UL or WH listed.
   8. Thickness: 5/8 inch.
   9. Edges: Tapered.

D. Backing Board For Wet Areas:
   1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Application: Surfaces behind tile at shower walls and kitchen and serving walls.
      b. Thickness: 1/2 inch.
   3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
      a. Application: Surfaces behind tile at toilet rooms and water fountains.
      b. Fire Resistant Type: Type X core, thickness 5/8 inch.

E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Type: Type X.
   5. Type X Thickness: 5/8 inch.
   6. Edges: Tapered.

F. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing, unless otherwise indicated.
   2. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
   3. Core Type: Type X.
   4. Thickness: 5/8 inch.
   5. Edges: Square.

G. Exterior Parapet Wall Sheathing Board: Sizes to minimize joints in place; ends square cut.
   1. Application: Exterior sheathing at the inside face of parapet walls.

2. Either product listed below may be used at Contractor's Option.
    a. Fiber-reinforced gypsum panels, ASTM C1278.
    b. Glass mat faced gypsum panels, ASTM C1177/C1177M.
3. Type X Thickness: 5/8 inch (16 mm).
4. Edges: Square, for vertical application.
5. Products:
    a. USG Corporation; Securock Gypsum-Fiber Roof Board.
    b. Georgia-Pacific Gypsum LLC; DensDeck Prime.
    c. Substitutions: See Section 01 6000 - Product Requirements.

H. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.

I. Perforated gypsum board panels.
1. Application: suspended cloud ceilings.
2. Size: 3 feet by 8 feet.
3. Thickness: 1/2 inch.
4. Insulation: Factory applied.
5. Mounting: Drywall suspension system (DWSS).
6. Perforation: 01, 3L1.
7. Finish: Field painted.
8. Product: Danoline by USG.

2.04 JOINT TREATMENT MATERIALS

A. Joint Materials: ASTM C475/C475Mand as recommended by gypsum board manufacturer for project conditions.
1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Ready-mixed vinyl-based joint compound.
3. Chemical hardening type compound.

B. Comply with Gypsum Association GA-236.

C. Joint Tape:
1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

D. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all purpose taping compound.
    a. Use all purpose compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all purpose, sandable compound.
4. Finish Coat: For third coat, use drying-type, all purpose, sandable compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all purpose, sandable compound.

E. Joint Compound for Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting- type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

F. Joint Compound for Tile Backing Panels:
   1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
   2. Water-Resistant Gypsum Backing Board: Use drying-type, all purpose, sandable compound.

2.05 GYPSUM WALLBOARD ACCESSORIES

A. Acoustic Insulation: As specified in Section 07 2100.
B. Acoustic Sealant: Single component, non-hardening, non-skinning, sealant for use in conjunction with gypsum board.
   1. Place two sealant beads between top stud runner and structure and between bottom stud track and floor.
   2. Sealant at electrical box cutouts, and all abutting dissimilar materials on both sides of partitions.
   3. Manufacturers:
      a. Tremco; Acoustical Sealant: www.tremcosealants.com.
      b. Owens Corning; QuietZone: www.owenscorning.com.
      c. USG Corporation; Sheetrock Acoustical Sealant: www.usg.com.
      d. Specified Technologies, Inc.: www.stifirestop.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.
C. Sealants (other than acoustic): As specified in Section 07 9200.
D. Water-Resistive Barrier: As specified in Section 07 2500.
E. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. General Types: As detailed on drawings or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide L-bead at exposed panel edges.
   3. Special Shapes:
      a. J-Trim: 701-A, 801-A manufactured by USG.
      b. J-Stop: 401 manufactured by USG.
      c. Corner Beads: BEADEX manufactured by USG.
      d. L- Trim Molding : DRML-1250 manufactured by Fry Reglet Corporation.
      e. Reveal: DRM-50-50 and DRM-50-200 manufactured by Fry Reglet Corporation.
      f. F-Reveal: FDM-625-50 manufactured by Fry Reglet Corporation.
      g. Z-Reveal: DRMZ-625-50 manufactured by Fry Reglet Corporation.
      h. W-Reveal: DRWT-50-50 manufactured by Fry Reglet Corporation.
      i. Column Collar Reveal: Clear anodized aluminum molding with stainless steel adjustable band and PVC spacer for plaster manufactured by Fry Reglet Corporation.
      j. Other shapes as detailed on drawings.
   4. Manufacturers:
      a. Same manufacturer as framing materials.
      b. Phillips Manufacturing Co: www.phillipsmfg.com.
      c. Trim-tex, Inc: www.trim-tex.com.
      d. USG: www.usg.com.
      e. Fry Reglet Corporation: www.fryreglet.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.
F. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
   1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches on center.
B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
   1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
   2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
   1. Fire rated partitions to be installed in accordance with UL V450 or UL V438 or UL U419 .
   2. All "Sound Rated" partitions shall extend to floor/roof deck.
B. Runner Track Installation:
   1. Install continuous runner tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure with suitable fasteners for the type of construction involved spaced not more than 16 inches (406 mm) on center, as required by design to resist lateral forces. Provide fasteners at corner and ends of tracks (unless shown otherwise on drawings).
      a. To Concrete: Use stud nails, power driven fasteners.
      b. To Steel Deck: Use 3/4 inch (19 mm) long pan head framing screws.
C. Stud Erection:
   1. Studs shall be plumbed, aligned, fully seated in the bottom runner and securely attached to the flanges of both top and bottom runners by 2 each screw fastening method. Studs shall be one piece full length; splicing is not permitted (except as approved by the Architect / Engineer). Jack studs or cripples shall be installed below window sills, above window and door heads, and elsewhere to furnish supports, and shall be securely attached to connecting members. Provisions for vertical structural movement shall be provided where shown on the drawings. Lateral bracing shall be provided by use of steel studs, securely fastened to the structure.
   2. Openings: Reinforce openings as required for weight of doors, windows, etc., using not less than double studs at jambs.
D. Supplementary Partition Framing:
   1. Install supplementary framing, blocking and bracing in metal framing system wherever partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings and similar work requiring attachment to the partition.
   2. Frame wall openings with proper framing to accommodate the opening size and applied loads. Frame both sides of control joints with separate studs.
   3. At stud furring on exterior walls, provide braced connections to back up wall at each 10 feet of height.
E. Refer to drawings for additional requirements for bracing of metal stud walls.

F. Blocking: Install mechanically fastened steel sheet blocking for support of:
   1. Framed openings.
   2. Wall mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall mounted door hardware.

3.04 ACOUSTIC ASSEMBLIES INSTALLATION

A. For all interior walls with insulation.
B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
   1. In walls with board on only one side, secure batts with plastic plumbers tape screwed to studs, 6" from top and bottom and every 24" OC (or similar method approved by architect) to prevent batts from falling out.
C. Acoustic Sealant: Install in accordance with manufacturer's instructions. and as follows
   1. Place two beads continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
B. General - Install so trim and reinforcing tape is fully backed by gypsum wallboard. No hollow spaces over 1/8 inch (3 mm) wide are permitted.
C. Cutting Gypsum Board:
   1. Gypsum board shall be cut either by scoring and breaking or by sawing, working from the face paper side. When scoring, a sharp knife shall be used to cut through the face paper into the gypsum core. The gypsum board shall be snapped back away from the cut face. Back paper shall be cut. As an alternate to cutting the back paper, the back paper shall be broken by snapping the gypsum board in the reverse direction.
      a. All cut edges and ends of gypsum boards shall be smoothed where necessary to obtain neat fitting joints when the gypsum board is installed.
   2. Holes for pipes, fixtures or other small openings shall be scored on both the face and back before removal of the cut-out with a saw or special tool designed for this purpose.
   3. Where gypsum board meets projecting surfaces, the gypsum board shall be scribed and neatly cut.
D. Single Layer Application:
   1. Apply ceiling first (if gypsum board).
   2. Use board of length to give minimum number of joints.
   3. On walls over 9 feet (2743 mm) high and on ceilings, apply board perpendicular to support.
   4. On walls under 9 feet (2743 mm) high, apply board parallel to support.
   5. Stagger end joints. End and edge joints of board applied on ceilings shall occur over framing members or be back blocked with blocking. End joints of board horizontally applied on walls shall occur over framing member. Edge joints of board vertically applied on walls shall occur over framing members.
   6. Butt edges in moderate contact. Do not force in place. Shim to level.

7. Leave facings true with joint, finishing flush. Vertical work shall be plumb and ceiling surfaces level.
8. Scribe work closely. Keep joints as far from openings as possible. If joints occur near an opening, apply wallboard so vertical joints are centered over openings. No vertical joints shall occur within 8 inches (203 mm) of external corners or openings.
9. Install board tight against support with joints even and true. Tighten loose screws.
10. Caulk perimeter joints in sound insulated rooms with specified acoustical sealant.
11. Provide 1/2 inch (13 mm) maximum gap at floor to bottom of gypsum board.

E. Double Layer Application (if required):
1. Apply base layer as specified for single layer application.
2. Apply face layer with joints staggered in relationship to base and occurring over supports. Use combination of adhesive and screws to meet Manufacturer's specifications for fire-rated assembly. Apply screws attaching face layer through base layer into support for specified penetration.

F. Fastening:
1. Apply from center of wallboard towards ends and edges.
2. Apply screws 3/8 inch (10 mm) minimum from ends and edges, 1 inch (25 mm) maximum from edges, and 1/2 inch (13 mm) maximum from ends.
3. Set screw heads 1/32 inch (0.8 mm) below plane of board, but do not break face paper. If face is accidentally broken, apply additional screw 2 inches (50 mm) away.
4. Screws on adjacent ends or edges shall be opposite each other.
5. Drive screws with shank perpendicular to face of board.
6. Walls (1-hour and 2-hour rated):
   a. Shall be 1-1/8 inch (29 mm) Type "S" bugle head screws. Spacing to be 8 inches (203 mm) on center at perimeter of wall and 8 inches (203 mm) on center vertically at each stud.
   b. Shall be 1-5/8 inch (41 mm) Type "S" bugle head screws at 2 layer installations.
7. Walls (non rated): Shall be 1 inch (25 mm) Type "S" bugle head screws; spacing to be 8 inches (203 mm) on center at perimeter of wall and panels, and 12 inches (305 mm) on center vertically at remaining studs.
   a. Also occurs at 5/8 inch (16 mm) gypsum board to (RC-1) resilient channel framing.
8. Suspended ceilings and soffits:
   a. Shall be 1-1/8 inch (29 mm) Type "S" bugle head screws. Spacing to be 8 inches (203 mm) on center at perimeters if panels and 8 inches (203 mm) on center at remaining channels spaced 24 inches (610 mm) on center.
   b. Shall be 1-5/8 inch (41 mm) Type "S" bugle head screws at 2 layer installations.

G. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

H. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
1. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.

I. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
    1. Unfinished Gypsum Board Surfaces, Above Ceilings, Behind Cabinetry and Under Acoustical Tile:
        a. GA-214 **Level Two** - All joints and interior angles shall have tape embedded in joint compound and one separate coat of joint compound applied over all joints, angles, fastener heads, and accessories. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable, except under acoustical tile. Includes fire and sound rated walls.
    2. Gypsum Board Surfaces in Mechanical, Storage, and Utility Areas to Receive Paint:
        a. GA-214 **Level Three** - All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. All joint compound shall be smooth and free of tool marks and ridges.
    3. Gypsum Board Surfaces to Receive Paint (standard wall finish):
        a. GA-214 **Level Four** - All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. All joint compound shall be smooth and free of tool marks and ridges.
    4. Gypsum Board Surfaces to Receive Paint, (only those surfaces noted on plans)
        a. GA-214 **Level Five** - All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges.
D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
    1. Feather coats of joint compound so that camber is maximum 1/32 inch.
E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.09 WORKMANSHIP

A. Holes for electrical outlets and for other purposes shall be accurately sized to fit. Any holes not able to be covered because of faulty cutting and workmanship shall be repaired to the satisfaction of the Architect.
B. Any rough joints, popped screws, poor application, or finish shall be repaired before any painting is performed.

C. Inspection of work with painter and Architect will be done after work is assumed completed in order to make any changes or corrections in the Work or material.

END OF SECTION 09 2116

SECTION 09 3000

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Tiling work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Tile for floor applications.
C. Tile for wall applications.
D. Ceramic accessories.
E. Movement joint material.
F. Tile edge protection.
G. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
B. Section 06 6116 - Solid Surfacing Fabrications: Thresholds.
C. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.
D. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.
E. Division 22 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
B. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
C. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
D. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
E. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2021.
F. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
D. Samples: Provide samples equal to 12 inches by 12 inches of every size, color and type.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Installer's Qualification Statement:
G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than 20 of each type.

1.06 QUALITY ASSURANCE

A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
C. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 MOCK-UPS

A. See Section 01 4300 - Quality Assurance for general requirements for mock-up.
B. Construct mock-up of Porcelain and Ceramic tiles with edge protection, incorporating all components specified.
    1. Minimum size of mock-up is 8 feet by 10 feet (2.4 m by 3 m) or as directed by Architect.
    2. When approved by Architect, mock-up shall become the acceptable standard of finish
    3. quality and workmanship for remainder of on-site work.
    4. Approved mock-up may remain as part of the Work, if undisturbed at time of substantial completion at the discretion of the Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.
B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

1.10 GUARANTEE

A. This Contractor shall guarantee his work for a period of One (1) yearfrom date of Substantial Completion. Guarantee shall be in form found in Section 01 7800.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products by the same manufacturer.
    1. Basis of Design: Dal-Tile Corporation: www.daltile.com.
    2. American Olean Corporation: www.americanolean.com.
    3. Dal-Tile Corporation: www.daltile.com.
    4. Substitutions: See Section 01 6000 - Product Requirements.

B. Floor Tile Finish **FT1** Colorbody Porcelain Mosaic (in Restroom areas where recessed slab occurs, using thick set mortar): ANSI A137.1, and as follows:
   1. Basis of Design Product: Daltile, Keystones Mosaic Tile.
   2. Composition: Unglazed Porcelain.
   3. Module Size: 1 inch by 1 inch, 1/4 inch thick.
   4. Pattern: Random Medley.
   5. Colors / Price Group:
      a. 50 percent Moonshine D117. Group 1.
      b. 25 percent Cypress D452. Group 2.
      c. 25 percent Spa D148. Group 3.

C. Floor Tile Finish **FT2** Unglazed Quarry Tile (located in Kitchen Areas): ANSI A137.1, and as follows:
   1. Basis of Design Product: Daltile, Quarry Textures Tile.
   2. Composition: Unglazed Porcelain.
   3. Module Size: 6 inches by 6 inches, 1/2 inch thick.
   4. Square Top, Cove Base. Refer to details on drawings.
   5. Colors/Price Group: Ashen Gray 0T03, Smooth Surface. Group 2.

D. Wall Tile Finish **WT1** Glazed Ceramic Wall Tile (at Group Restrooms): ANSI A137.1, and as follows:
   1. Basis of Design Product: Daltile, Color Story Pinstripes.
   2. Composition: Glazed Ceramic.
   3. Module Size: 2 inches by 8 inches, 5/16 inch thick.
   4. Pattern: As shown on drawings.
   5. Colors / Price Group:
      a. Tranquility 0059 (FLUTED and WAVE CREST).
      b. Stable 0055 (FLUTED and WAVE CREST).

E. Wall Tile Finish **WT2** Ceramic Wall Tile (at Pre-K and Kindergarten Restrooms): ANSI A137.1, and as follows:
   1. Basis of Design Product: Daltile, Classic Color Wheel.
   2. Composition: Glazed Ceramic.
   3. Module Size: 3 inches by 6 inches, 6 inches by 6 inches,
   4. Pattern: As shown on drawings.
   5. Colors / Price Group:
      a. Garden Spot 0141. Group 3.
      b. Spa 0148. Group 1.
      c. White 0100. Group 1.

F. Wall Tile Finish **WT3** Ceramic Wall Tile (at all Custodial/Janitor Sink locations): ANSI A137.1, and as follows:
   1. Basis of Design Product: Daltile, Color Wheel - Classic (previously called Semi-Gloss/Matte).
   2. Composition: Glazed Ceramic.
   3. Module Size: 6 inches by 6 inches, 5/16 inch thick.
   4. Pattern: Pattern as shown on drawings.
   5. Colors/Price Group:
      a. White 0100. Group 1.

G. Wall Tile Finish **WT4** Glazed Porcelain Wall Tile (at Corridor): ANSI A137.1, and as follows:
   1. Basis of Design: Daltile, Volume 1.0.
   2. Composition: Glazed Porcelain.
   3. Module Size: 12 inches by 24 inches, 5/16 inch thick.
   4. Pattern: 12 by 24 and cut down to 6 inches by 24 inches as shown in drawings.
   5. Colors/Price Group:

a. Vapor VL63, 12 inches by 24 inches.

H. Wall Tile Finish **WT5** Glazed Ceramic Wall Tile (Main Entry): ANSI 137.1, and as follows:
1. Basis of Design Product: Daltile, Color Story Pinstripes.
2. Composition: Glazed Ceramic.
3. Module Size: 2 inches by 8 inches, 5/16 inch thick.
4. Pattern: As shown on drawings.
5. Colors/Price Group:
a. Tranquility 0059 (FLUTED), 20 percent.
b. Balance 0014 (FLUTED), 30 percent.
c. Ice White 0025 (FLUTED), 50 percent.

I. Wall Tile Finish **WT6** Glazed Ceramic Wall Tile (at Kitchen): ANSI A137.1, and as follows:
1. Basis of Design Product: Daltile, Classic Color Wheel.
2. Composition: Glazed Ceramic.
3. Module Size: 3 inches by 6 inches, 5/16 inch thick.
4. Pattern: As shown on drawings.
5. Colors/Price Group:
a. Spa 0148. Group 3.
b. White 0100. Group 1.

2.02 NON-CERAMIC TRIM AND ACCESSORIES:

A. Basis of Design: Schluter Systems www.schluter.com.
B. Non-Ceramic Trim: Satin Anodized Aluminum Finish, Profiles by Schluter Systems.
C. Finishing and Edge-Protection Profiles for Walls and Tile Base:
1. Schluter-QUADEC - Typical Edge Protection.
a. Description: Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer. Use at all outside corners and at any perimeter locations where tile edge is exposed.
b. Corners:
1) Provide with matching inside and outside corners.
2) Provide with matching end caps.
3) Provide with matching connectors.
c. Material and Finish:
1) AE - Satin Anodized Aluminum.
(a) Height as required to coordinate with tile selection and setting system selected.

D. Type 1 - Profile for Walls and Tile Base.
1. Schluter-JOLLY - Typical Edge Protection.
a. Description: Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer. Use for special applications in kitchen, at bottom of wall tile, above 4-inch-high resinous cove base. Terminations at door and window frames. As detailed in drawings.
b. Corners:
1) Provide with matching outside corners.
2) Provide with matching end caps.
3) Provide with matching connectors
c. Material and Finish:
1) AE - Satin Anodized Aluminum.
(a) Height as required to coordinate with tile selection and setting system selected.

E. Type 3 - Cove Shaped Profile
1. Schluter-DILEX-AHK - Typical.

a. Description: Anodized aluminum profile with integrated trapezoid-perforated anchoring legs, connected at a 90-degree angle by a cove-shaped section with 3/8 inch (10 mm) radius that forms the visible surface.
b. Corners:
1) Provide with inside corners and floor to wall transitions.
c. Material and Finish:
1) AE - Satin Anodized Aluminum.
(a) Height as required to coordinate with tile selection and setting system selected.

F. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
1. Thickness: 1/2 inch.
2. Material: Marble, honed finish.
3. Material: Solid surface acrylic resin, mineral filler, and pigments; non-porous, color and pattern consistent throughout thickness.
a. Install only, furnished by 06 6116 Solid Surface Fabrications.
4. Material: Artificial stone tile; 93 percent quartz aggregate, resin, color pigments.
5. Material: Natural quartz blended with unsaturated polyester resins, polished high gloss finish; depth to match depth of wall by full width of opening; 0.787 inches (20 mm) thick; beveled one long edge with radiused corners on top side; without open seams.
6. Color and Pattern: As indicated on drawings.

2.03 SETTING MATERIALS

A. All setting products shall be supplied by a single source supplier.
B. Provide setting materials produced by the same manufacturer as the grout.
C. Manufacturers:
1. Mapei Corporation: www.mapei.com.
2. CUSTOM Building Products: www.custombuildingproducts.com.
3. LATICRETE International, Inc: www.laticrete.com.
4. Substitutions: See Section 01 6000 - Product Requirements.
D. Premium Grade Non-sag, polymer-modified, LFT Mortar: complying with ANSI A118.4 , ANSI A118.11 and ISO 13007 C2TES1P1.
1. Acceptable Products:
a. Ultraflex LFT manufactured by Mapei.
1) Approved for floor and wall applications.
b. Versabond LFT.
1) Approved for floor applications only (lower bond strength).
c. Prolite Premium LFT by Custom.
1) Approved for floor and wall applications.
E. Premium Grade, Thin-set Mortar: Dry-Set, polymer-modified Portland cement mortar, complying with ANSI A118.4, ANSI A118.11, and ISO 13007 C2ES1P2.
1. Acceptable Products:
a. Kerabond/ Keralastic System manufactured by Mapei.
b. Prolite Premium by Custom.
c. Versabond Professional Thinset.
F. Thick Mortar Bed Materials: Portland cement and sand and water, complies with ANSI A118.4.
1. Mortar bed to be uniform 2-inch thickness.
2. Cement and Sand Pre-Mix Products if required by owner.
G. Reinforcing Mesh: 2 inch by 2 inch size weave of 16/16 wire size; welded fabric, galvanized; ANSI A108.1a.
1. Required in all Thick Beds.

2.04 GROUTS

A. Acceptable Manufacturers:
   1. Mapei Corporation: www.mapei.com.
   2. CUSTOM Building Products: www.custombuildingproducts.com.
   3. LATICRETE International, Inc: www.laticrete.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.
B. All in One grout for joints from 1/16 inch to 3/4 inch.
   1. Ultracolor Plus FA by Mapei.
C. Sanded Grout: High-Performance, quick-set, polymer modified grout complying with ANSI A118.6, ANSI A118.7 and ISO 13007 CG2WAF, for joints between 1/8 inch wide and greater.
   1. Acceptable Products:
      a. Ultracolor Plus by Mapei.
      b. Prism by Custom.
   2. Colors: To be selected by Architect from manufacturer's full range.
D. Non-Sanded Grout: Premium Grade, polymer modified unsanded, Portland cement tile grout. Complies with: ANSI A118.6 and ISO 13007 CG2WAF, for joints less than 1/8 inch wide.
   1. Acceptable Products:
      a. Keracolor U by Mapei.
      b. Polyblend by Custom.
   2. Colors: To be selected by Architect from manufacturer's full range.

2.05 ACCESSORY MATERIALS

A. Acceptable Manufacturers:
   1. Mapei Corporation: www.mapei.com.
   2. Custom Building Products: www.custombuildingproducts.com.
   3. LATICRETE International, Inc: www.laticrete.com.
   4. Schluter-Systems: www.schluter.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.
B. Premium Waterproofing and Crack Isolation Membrane: Pre-mixed liquid rubber, quick-drying waterproofing and crack isolation membrane. Complying with: ANSI A118.10 and ANSI A118.12.
   1. **To be used under all tile floors.**
   2. Acceptable products:
      a. Aqua Defense by Mapei.
      b. Redgard by Custom.
C. Silicone Sealant: Silicone sealant, moisture and mildew resistant type, clear.
D. Grout Sealer: Premium, no-sheen, water-based, penetrating sealer to provide stain protection, complies with: Excellent stain resistance to most household contaminants (CTI-072).
   1. Acceptable Products:
      a. Aqua Mix Sealer's Choice Gold by Custom.
E. Perimeter Joint Material: Caulked Joint will be acceptable as per ANSI and TCNA Standards.
F. Control Joint Material: Profile with integrated rigid, recycled PVC, trapezoid-perforated anchoring legs, connected by a 3/8 inch (10 mm) wide soft CPE movement zone that forms the visible surface. Color as selected by Architect. Height as required.
   1. Product: DILEX-BWB manufactured by Schluter Systems (www.schluter.com) or equal.
   2. Spacing and location as recommended by Tile Manufacturer and approved by Architect.
G. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
   1. Applications: Between tile and plumbing fixtures, at all changes in plane and junction of tile and dissimilar materials.

2. Color(s): As selected by Architect from manufacturer's full line.
3. Products:
    a. ARDEX Engineered Cements; ARDEX Flex Caulk: www.ardexamericas.com.
    b. Custom Building Products; Commercial 100 percent Silicone Caulk: www.custombuildingproducts.com.
    c. LATICRETE International, Inc; LATICRETE Latasil: www.laticrete.com.
    d. Merkrete, by Parex USA, Inc; Merkrete Colored Caulking: www.merkrete.com.
    e. ProSpec, an Oldcastle brand; ProColor Advantage Caulk: www.prospec.com.
    f. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that recessed floors with drains have required slope to drain.
    1. Report any non comforming recessed floors to Architect / General Contractor.
B. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
D. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
E. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
    1. Test as Follows:
        a. Alkalinity (pH): ASTM F710.
        b. Internal Relative Humidity: ASTM F2170.
        c. Moisture Vapor Emission: ASTM F1869.
    2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
    3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
F. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.
B. Vacuum clean surfaces and damp clean.
C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

A. Install movement joints in accordance with requirements of TCNA EJ171 Guidelines and manufacturer's instructions.
    1. Keep movement/expansion/control joints free of adhesive or grout. Apply sealants to joints.
B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.
G. Install thresholds where indicated.
H. Sound tile after setting. Replace hollow sounding units.
I. Keep control and expansion joints free of mortar, grout, and adhesive.
    1. Apply sealants to joints
J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated., refer to grout specifications for use and locations.
L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
    1. Keep joints free of mortar, grout, and adhesive.
M. Apply sealant to junction of tile and dissimilar materials.

3.04 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F112, bonded, unless otherwise indicated.
    1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCNA (HB) Method F121.
B. Waterproofing and Crack Isolation Membrane: Install as recommended by manufacturer .
C. Mortar Bed Thickness: 1 1/4 inches (31 mm) minimum to 2 inches (51 mm) maximum.

3.05 INSTALLATION - SHOWERS

A. At tiled shower receptors install in accordance with TCNA (HB) Method B414, mortar bed floor, and W201, mortar bed over concrete or masonry walls.
B. Grout with standard grout as specified above.
C. Seal joints between tile work and other work.

3.06 INSTALLATION - WALL TILE (THIN-SET)

A. Over coated glass mat backer board on studs.
    1. Bed self-adhesive 2 inch wide fiberglass mesh tape in bead of flexible sealant. Then, embed the tape with same material used to set tiles. Pull tile setting materials tightly over joint to reduce crown in joint area. Allow tile setting material to dry prior to setting tile.
    2. Install in accordance with The Tile Council of North America Handbook Method TCNA (HB) W245 Thin-Set.
B. Waterproofing Membrane: Install as specified in ANSI A108.13 or manufacturer's directions.

3.07 INSTALLATION - WALL TILE (THICK-SET)

A. Over interior masonry or concrete, install in accordance with TCNA (HB) Method W211 Thick-Set, (Waterproof Membrane at Shower Locations).
B. Waterproofing Membrane: Install as specified in ANSI A108.13 or manufacturer's directions.

3.08 INSTALLATION - CEILING TILE

A. Over fiber-cement backer board on studs, install in accordance with The Tile Council of North America Handbook Method C315 Thin-Set.

3.09 INSTALLATION - PRE-CAST CONCRETE STAIR TREADS

A. Anti-Fracture Membrane: Prime and install anti-fracture membrane on stair substrate per manufacturer's recommendations.
B. Pre-cast concrete:
    1. Install using latex-portland cement mortar applied in a full bed method.

2. Set treads level and plumb to meet finished nosing layout marks.
3. Tool front mortar joint smooth and uniform.
4. Seal joints as directed by Architect only.

3.10 INSTALLATION - CEILING TILE

A. Over fiber-cement backer board on studs, install in accordance with The Tile Council of North America Handbook Method C315 (Thin-Set).

3.11 CLEANING AND SEALING

A. Clean tile and grout surfaces.
B. Seal all wall, ceiling, and floor grout conditions along with all floor tile per manufacturer's recommended application rates and procedures.

3.12 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 3000

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SECTION 09 5100

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.02 SUMMARY

A. Section Includes:
   1. Linear acoustical ceiling and wall panels
   2. Exposed grid suspension system
   3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories

B. Related Sections:
   1. Section 09 5000 – Ceilings
   2. Section 09 5113 – Acoustical Panel Ceilings
   3. Section 09 5300 – Acoustical Ceiling Suspension Assemblies
   4. Section 09 5400 – Specialty Ceilings
   5. Section 09 5433 – Decorative Panel Ceilings
   6. Section 09 5453 – Fiberglass Reinforced Panel Ceilings

C. Alternates
   1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products that have not been pre-approved by the architect and included in the Addenda, the originally specified products shall be provided without additional compensation.
   2. Submittals that do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers; Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
   2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
   3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   4. ASTM C423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
   6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

7. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
12. ASTM E1264 Classification for Acoustical Ceiling Products

B. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
C. ASHRAE Standard 62.1-2004, “Ventilation for Acceptable Indoor Air Quality”
D. ICC ESR 1308 International Code Council Evaluation Report Independent Evaluation of Armstrong Suspension Components for Seismic Installations
E. International Building Code
F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
G. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
H. LEED - Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.04 SYSTEM DESCRIPTION

A. Discontinuous

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
B. Samples: Minimum 6” x 6” submittal sample of specified blade color; 8 inch long sample of suspension system, including main runner and cross tee.
C. Shop Drawings: Layout and details of acoustical ceilings show locations of items, which are to be coordinated with, or supported by the ceilings.
D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification, such as Underwriter’s Laboratory (UL) of NRC.
    1. If the material supplied by the acoustical subcontractor does not have an independent laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of, and replaced with complying product at the expense of the Contractor performing the work.

1.06 SUSTAINABLE MATERIALS

A. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.
B. End of Life Programs/Recycling: Where applicable, manufacturers that provide the option for recycling of their products into new products at end-of-life through take-back programs will be preferred.
C. Products meeting LEED V4 requirements including:
    1. Storage & Collection of Recyclables
    2. Construction and Demolition Waste Management Planning
    3. Building Life-Cycle Impact Reduction
    4. Building Product Disclosure and Optimization Environmental Product Declarations
    5. Building Product Disclosure and Optimization Sourcing of Raw Materials
    6. Building Product Disclosure and Optimization Material Ingredients
    7. Construction and Demolition Waste Management

1.07 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
    1. Surface Burning Characteristics: Class A as follows, tested per ASTM E84 and CAN/ULC S102:
        a. Flame Spread: 25 or less
        b. Smoke Developed: 50 or less
C. Handle acoustical blades carefully to avoid scratching or denting units in any way.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.09 PROJECT CONDITIONS

A. Space Enclosure:
    1. All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.

2. HumiGuard Plus Ceilings: Installation of the products shall be carried out where the temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc.) must be complete and dry. The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory and does not protect other materials that contact the treated surface such as supported insulation materials.

1.10 WARRANTY

A. Blades: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
   1. Blade Panels: Sagging and warping as a result of defects in materials or factory workmanship.
   2. Grid System: Rusting and manufacturer's defects
B. Warranty Period:
   1. Blades: One (1) year from date of substantial completion
   2. Suspension System: Ten (10) years from date of substantial completion
C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.11 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
B. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - Acoustical Ceiling Blades:
   1. SoundScapes Blades by Armstrong World Industries Inc. www.armstrong.com.
   2. Suspension System: Armstrong World Industries Inc.
B. Other Approved Manufacturers, Acoustical Ceiling Units:
   1. Rockfon, LLC: www.rockfon.com.
   2. CertainTeed Corporation: www.certainteed.com.
   3. USG: www.usg.com.
   4. ONNiT Systems: www.onnitsystems.com.
   5. Alternative Manufacturers may be considered under approval of Architect. For substitutions, see Section 01 6000 - Product Requirements.

2.02 ACOUSTICAL CEILING TILE TYPES

A. Acoustical Tile Type **CT1**: Mineral Fiber, ASTM E 1264 Type III or type XX, with the following characteristics:
   1. Size: 24 inches by 48 inches (600 mm by 1200 mm).
   2. Thickness: 5/8 inches.
   3. Light Reflectance: .85 percent, determined in accordance with ASTM E 1264.

4. NRC: 0.75, determined as specified in ASTM E 1264.
5. Articulation Class (AC): 180, determined as specified in ASTM E 1264.
6. Ceiling Attenuation Class (CAC): 23, determined in accordance with ASTM E 1264.
7. Edge: Square.
8. Surface Color: To be selected by Architect from manufacturer's standard line.
9. Suspension System: Exposed grid Type 1.
10. Products:
    a. Artic by Rockfon; www.rockfon.com.
    b. Substitutions: See Section 01 6000 - Product Requirements.

B. Ceiling Tile Type **CT2**: Vinyl Faced Gypsum, ASTM E 1264 Type III or type XX, Pattern G with the following characteristics:
1. Size: 24 inches by 48 inches (600 mm by 1200 mm).
2. Thickness: 1/2 inch.
3. Light Reflectance: 0.77 percent, determined as specified in ASTM E 1264.
4. Ceiling Attenuation Class (CAC): 40, determined as specified in ASTM E 1264.
5. Edge: Square.
6. Surface Color: White.
7. Panel Features: Washable, scrubbable, soil and impact resistant finish. Meets USDA/FSIS guidelines for use in food processing areas.
8. Suspension System: Exposed grid Type 1.
9. Products:
    a. 3270 Sheetrock Lay-In ClimaPlus by USG.
    b. 1140-CRF-1 Vinylrock by CertainTeed.
    c. 7771.01V Endure by Chicago Metallic.
10. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACOUSTICAL CEILING BLADES

A. Surface Texture: Fine.
B. Composition: Fiberglass.
C. Color: Provide full color range including custom colors from Manufacturer.
D. Size & Design: 10 x 94 x 1-3/4” Rectangle (item 8250F03RH02).
E. Edge Profile: Square.
F. Recycled Content: 43%.
G. Acoustics: Sound absorption up to 1.80 Noise Reduction Coefficient (NRC) ASTM C423 dependent on blade depth and spacing:

Panel Depth	6” O.C.	12” O.C.	18” O.C.	24” O.C.
10”		0.80		

H. Flame Spread: ASTM E1264; Class A (UL)
I. Dimensional Stability: HumiGuard Plus; Anti-Microbial, inherent
J. Basis of Design: SoundScapes Blades as manufactured by Armstrong World Industries
K. Products shall comply with the Build America, Buy America Act (BABA)

2.04 METAL SUSPENSION SYSTEMS

A. Direct-to-Grid Suspension Acceptable Product: Listed Below as manufactured by Armstrong World Industries, Inc. Items are available in custom colors; contact ASQuote@armstrongceilings.com.
1. 360-degree painted Black (BL) as manufactured by Armstrong World Industries:
    a. XL734036 4’ Cross Tee

B. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

C. Seismic Accessories Required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.02 PREPARATION

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
   1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.
B. Install after major above-ceiling work is complete.
C. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SOUNDSCAPES BLADES

A. Install SoundScapes Blades per Armstrong World Industries installation instructions.
B. For areas having seismic requirements, consult with the Authority Having Jurisdiction or Building Code to determine the local requirements and following the manufacturers seismic guidelines found in the manufacturers Installation instructions.
C. Install suspension system per ASTM C636 unless otherwise noted in the manufactures Installation Instructions.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Lay directional patterned units with pattern parallel to longest room axis.
B. Fit border trim neatly against abutting surfaces.
C. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.
D. Where round obstructions and bullnose concrete block corners occur, provide preformed closures to match perimeter molding.
E. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated.
F. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
G. Install hold-down clips on panels within 20 ft of an exterior door.
H.

3.05 ADJUSTING AND CLEANING

A. Replace damaged and broken blades.
B. Clean exposed surfaces of blades, including trim, and suspension members comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5100

SECTION 09 6500

RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Resilient Flooring work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Resilient sheet flooring.
C. Rubber stair flooring, riser, tread, and accessories.
D. Installation accessories.
E. Floor finishing accessories.
F. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.
C. Section 09 6800 - Carpeting: Transitions to entrance flooring and broadloom carpet; application of resilient base in carpet contexts.
D. Division 26 - Electrical: Electrical Floor Cover plates for installation of resilient flooring specified in this section.

1.03 REFERENCE STANDARDS

A. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2021a, with Editorial Revision.
B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.
F. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading; 2017.
G. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
H. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
I. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019.
J. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015 (Reapproved 2020).
K. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
L. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2019.

M. NFPA 258 - Recommended Practice for Determining Smoke Generation of Solid Materials; 2001.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts. Provide details of special patterns.
D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
E. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
F. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
I. Manufacturer's Field Reports: Manufacturer's field reports specified herein.
J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Flooring Material: 2 cartons or 5 percent of each type and color.
    3. Extra Wall Base: 50 linear feet of each type and color.
    4. Extra Stair Materials (if used): Quantity equivalent to 5 percent of each type and color.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
    1. Whenever possible, provide each type of resilient flooring as provided by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum three yearsdocumented experienceand approved by flooring manufacturer.
C. Regulatory Requirements:
    1. Fire Performance Characteristics: Provide resilient linoleum tile flooring with the following fire performance characteristics as determined by testing products in accordance with ASTM method indicated below by a certified testing laboratory or another testing and inspecting agency acceptable to authorities having jurisdiction:
    2. Critical Radiant Flux: Class 1 Rating per NFPA 253 (ASTM E648) (0.45 watts/cm² or greater).
    3. Smoke Density: Less than 450 per NFPA 258 (ASTM E662).

1.06 DELIVERY, STORAGE, AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
C. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
   1. Material should be stored in areas that are fully enclosed, weathertight with the permanent HVAC system set at a uniform temperature of at least 68 degrees F (20 degrees C) for 48 hrs. prior to, during and after installation.
   2. Move resilient flooring and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are required by manufacturer.

E. Protect roll materials from damage by storing as recommended by manufacturer.

1.07 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

B. Substrate Conditions: Use the methods described below to determine the dryness and pH as required to ensure initial and long-term success. Testing to be done by an Independent Testing Agency, refer to Section 01 4000.
   1. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
      a. This test method covers the quantitative determination of percent relative humidity in concrete slabs for field or laboratory tests.
      b. The relative humidity measured from the center of the concrete slab should not exceed 75 percent. If the test results exceed the limitations, the installation must not proceed until the problem has been corrected.
      c. Report the following information:
         1) Name and address of the structure.
         2) Date and time measurements were made. Name, title, and affiliation of worker performing the measurements.
         3) Locations and depths of probe holes within the structure.
         4) Relative humidity in each probe hole, to the nearest percent relative humidity.
         5) Temperature in each probe hole, to the nearest degree Celsius (Fahrenheit).
         6) Ambient air temperature, to the nearest degree Celsius (Fahrenheit) and relative humidity (to the nearest percent relative humidity) above each probe hole.
         7) Make, model, and last calibration date of the instrument used to make the measurements.
         8) Report any observations that might affect the interpretation of individual measurements such as standing water on the slab, wet coring operations, weather, or ventilating system operations.
   2. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride:
      a. This test method covers the quantitative determination of the rate of moisture vapor emitted from below-grade, on-grade, and above-grade (suspended) concrete floors.
      b. The moisture vapor emissions rate should not exceed 5.0 lbs per 1,000 square feet within a 24-hour period. If the test results exceed the limitations, the installation must not proceed until the problem has been corrected.
      c. Number of Tests and Locations:
         1) Perform three tests for the first 1000 ft2 (100 m2) and at least one additional test for each additional 1000 ft2 (100m2). Select test locations to provide information about moisture distribution across the entire concrete floor slab, especially areas of potential high moisture. For slabs on-grade and below-grade, include a test location within 1 m (3 ft) of each exterior wall.

2) The General Contractor shall be responsible for conducting one calcium chloride test for every 1,000 square feet (minimum 3 tests) to ensure concrete moisture emissions do not exceed 5.0 lbs per 1,000 square feet within a 24-hour period. If the test results exceed the limitations, the installation must not proceed until the problem has been corrected.
3) Report the following information:
   (a) Name and address of the structure.
   (b) Date and time measurements were made.
   (c) Name, title, and affiliation of worker performing the measurements.
   (d) Diagram of the area showing the locations of tests within the structure.
   (e) Results of each test conducted
4) Report any observations that might affect the interpretation of individual measurements such as standing water on the slab, wet coring operations, weather, or ventilating system operations.

3. Contingency for High Moisture Readings: If at the time of testing the moisture readings are in excess of 5.0 lbs the General Contractor will initiate testing using petrographic analysis to determine if the Water Cement Ratio and sufficient hydration has taken place. If the Specifications were not followed in their entirety, water/cement ratio (as specified), and or the concrete surface has been inadequately hydrated the Contractor responsible for the placement of the cement shall be responsible for the costs associated with the petrographic analysis and subsequent remediation requirements.
4. Concrete pH Test: Perform pH tests on concrete floors regardless of the age or grade level. If the pH is greater than 10, it must be neutralized prior to beginning the installation.

C. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations, areas to receive flooring should be clean, fully enclosed and weathertight with the permanent HVAC system operational and set at a minimum of 68 degrees F (20 degrees C) for a minimum of 7 days prior to, during, and 7 days after the installation. The flooring material should be conditioned in the same manner for at least 48 hours prior to the installation. Maximum temperature should not exceed 100 degrees F after installation. Areas to receive flooring shall be adequately lighted to allow for proper inspection of the substrate, installation and final inspection.
D. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.
E. Finishing Operations: Install resilient flooring after finishing operations, including painting and ceiling operations, have been completed.

1.08 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.
B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
   1. Warranty Period: Five (5) year limited warranty commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Mohawk Group: www.mohawkgroup.com.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SHEET FLOORING

A. Commercial Grade Homogeneous Resilient Sheet without backing, with color and pattern throughout full thickness.
   1. Basis of Design Product:
      a. Medella Fleck (C2061) and Medella Hues (C2062) by Mohawk Group.
      b. Substitutions: See Section 01 6000 - Product Requirements.
   2. Flexibility: ASTM F137.
   3. Classification: ASTM F1303 - Type 1, Grade 1, Class A.
   4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   5. Thickness: 0.080 inch nominal. ASTM F38
   6. Sheet Width: 6' 7" (2.0 m).
   7. Static Load Resistance: 750 psi minimum, when tested as specified in ASTM F970.
   8. Seams: Heat welded.
   9. Colors: Fog 84982, Sage H5632, Deep Grey H5302, Steel Light H5328.

2.03 STAIR COVERING

A. Stair Tread with Integrated Riser: Rubber; full width and depth of stair tread in one piece; tapered thickness; nosing not less than 1-5/8 inch deep.
   1. Minimum Requirements: Comply with FS RR-T-650 requirements corresponding to type specified.
   2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
   3. Nominal Thickness: 0.1875 inch.
   4. Nosing: Square.
   5. Style: Raised disk pattern.
   6. Color: To be selected from manufacturer's full range by Architect.
   7. Manufacturers and Products:
      a. Basis of Design:
         1) Roppe Corp.; Product - "Vantage Raised Circular #96": www.roppe.com.
      b. Other Approved Manufacturers and Products:
         1) Johnsonite, Inc; Product - "Roundel Round Raised Disk, RTR-RD": www.johnsonite.com.
         2) Flexco, Inc.; Product - "Radial II, Type 1700 Textured": www.flexcofloors.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

B. Stair Treads: Rubber; full width and depth of stair tread in one piece; tapered thickness.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company: www.johnsonite.com.
      b. Mannington Commercial: www.manningtoncommercial.com.
      c. Roppe Corporation; Rubber Stair Treads: www.roppe.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. Nominal Thickness: 0.1875 inch.
   5. Nosing: Square.
   6. Color: To be selected by Architect from manufacturer's full range.
   7. Style: Contrasting color abrasive grit strips full width.

C. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
   1. Manufacturers:
      a. Flexco Inc.: www.flexcofloors.com.
      b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com.
      c. Mannington Commercial; _____: www.manningtoncommercial.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
   2. Thickness: 0.080 inch.

D. Stair Nosings: 1-1/2 inch horizontal return, 1-1/8 inch vertical return, full width of stair tread in one piece.
   1. Manufacturers:
      a. Balco, Inc; IllumiTread Egress: www.balcousa.com.
      b. Johnsonite, a Tarkett Company: www.johnsonite.com.
      c. Mannington Commercial: www.manningtoncommercial.com.
      d. Roppe Corporation: www.roppe.com.
   2. Material: Rubber.
   3. Nominal Thickness: 0.125 inch.
   4. Color: To match stair treads.
   5. Pattern: Abrasive insert strip.

2.04 RESILIENT BASE

A. **Type B2** Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers:
      a. Basis of Design:
         1) Mohawk Group Elemental Edges: www.mohawkgroup.com.
   2. Other Approved Manufacturers:
      a. Roppe Corp. Vantage Raised Circular #96: www.roppe.com.
      b. Flexco Inc.: www.flexcofloors.com.
      c. Johnsonite, a Tarkett Company: www.johnsonite.com.
      d. Mannington Commercial: www.manningtoncommercial.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.
   4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   5. Height: 4 inch.
   6. Thickness: 0.125 inch.
   7. Finish: Satin.
   8. Length: Roll.
   9. Color: Aircraft Carrier 073.
   10. Accessories: Premolded external corners, internal corners, and end stops.

2.05 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
C. Resilient Transition Strips:
   1. Carpet to MCT - CTA-XX-A manufactured by Johnsonite, Inc.
   2. Carpet to Concrete - CTA-XX-P manufactured by Johnsonite, Inc.
   3. MCT to Concrete: SSR-XX-B manufactured by Johnsonite, Inc.
   4. MCT to Stair Nosing - #1 Nosing by ROPPE.
   5. Linoleum to Concrete: RRS-XX-B manufactured by Johnsonite, Inc.
D. Moldings and Edge Strips: Resilient moldings and edge strips.

1. Manufacturers:
    a. Mannington Commercial: www.manningtoncommercial.com.

E. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
    1. Test in accordance with Section 09 0561.
    2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
B. Surface Preparation: Prepare floor substrate to be smooth, rigid, flat, permanently dry, clean and free of foreign materials such as dust, paint, grease, oils, solvent, curing and hardening compounds, sealers, asphalt and old adhesive residue.
C. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
D. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
E. Prohibit traffic until filler is fully cured.
F. Clean substrate.
G. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Adhesive-Applied Installation:
    1. Spread only enough adhesive to permit installation of materials before initial set.
    2. Fit joints and butt seams tightly.
    3. Set flooring in place, press with heavy roller to attain full adhesion.
D. Loose-Laid Installation: Set flooring in place in accordance with manufacturer's instructions.
E. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
F. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
    1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
    2. Resilient Strips: Attach to substrate using adhesive.
G. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
H. Install flooring in recessed floor access covers, maintaining floor pattern.

I. At movable partitions, install flooring under partitions without interrupting floor pattern.
J. Install custom designs, patterns and feature strips where indicated.

3.04 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
B. Seams are prohibited in bathrooms, kitchens, toilet rooms, and custodial closets.
C. Seal seams by heat welding where indicated.
D. Chemically bond seams using seam sealer where indicated. ????

3.05 INSTALLATION - TILE FLOORING

A. Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter
C. Lay tiles square with room axis, unless otherwise indicated CL Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures.
    1. Discard broken, cracked, chipped, or deformed tiles.
D. Lay border/accent tiles with grain running in one direction.
E. Lay field color tiles in basket-weave pattern with grain direction alternating in adjacent tiles.
F. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
G. Extend tiles into toe spaces, door reveals, closets, and similar openings.
H. Maintain reference markers, holes, and openings that are in place or marked for future cuffing by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent, non-staining marking device.
I. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times
J. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
K. Roll resilient flooring using 100 lbs roller as required by resilient flooring manufacturer.
L. Do not install resilient flooring over expansion joints. Use expansion joint covers manufactured for use with resilient flooring. Refer to Section 07 9513 for expansion joint covers.
M. Finish Flooring Patterns: As selected and detailed by Architect.

3.06 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
C. Install base on solid backing. Bond tightly to wall and floor surfaces.
D. Scribe and fit to door frames and other interruptions.

3.07 INSTALLATION - STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread.
B. Install stringers configured tightly to stair profile.

C. Adhere over entire surface. Fit accurately and securely.

3.08 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.
B. Clean resilient flooring in accordance with manufacturer's instructions.
C. Tile Flooring:
   1. Sweep and/or dust all floors.
   2. Scrub floor using “Stride” neutral cleaner. Rinse floor thoroughly.
   3. Do not perform initial maintenance for a minimum of 5 days after installation has been completed. This is to allow the adhesive the proper time to set.

3.09 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.
B. Protect installed product and finish surfaces from damage during construction. Remove and dispose of protective covering at time of Substantial Completion.

3.10 SCHEDULE - REFER TO DRAWINGS

END OF SECTION 09 6500

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SECTION 09 6800

CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Sheet Carpeting work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Broadloom carpet, direct-glued, at all classrooms, administration areas, media center, and corridors.
C. Matching roll carpet for direct-glue installation on base.
D. Entrance flooring carpet tile, direct-glued, at all entrance areas.
E. Accessories.
F. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied carpet.
B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.
C. Section 09 6500 - Resilient Flooring: Resilient base.
D. Section 09 6900 - Access Flooring.

1.03 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2021.
D. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
E. CRI 105 - Standard for Installation of Residential Carpet; 2015.
F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
C. Shop Drawings: Indicate seaming plan, method of joining seams, direction of carpet pileand pattern, location of edge moldings and edge bindings, layout of flat wire system.
D. Samples: Submit two samples 12 inches by 12 inches in size illustrating color and pattern for each carpet and cushion material specified.
E. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
F. Submit two, 6 inch long samples of stair nosing, edge strip and transition strip for each color specified.

G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
H. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional requirements.
    2. Extra Carpet: 200 sq ft of each type, color, and pattern installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet with minimum three years documented experience.
B. Installer Qualifications: Company specializing in installing carpet with minimum five years documented experience and approved by manufacturer.
C. Installer shall be approved by the Floor Covering Installation Board and/or can demonstrate compliance with its certification program requirements. Installer shall furnish upon request of owner or Architect, five (5) references from commercial carpet projects of similar scope, completed within the last five (5) years.
    1. Flooring contractor must be approved by the manufacturer prior to bid.
    2. Installer shall furnish, upon request of owner or architect, five references from commercial carpet projects of similar scope completed within the last five years.
    3. Flooring contractor possessing the contract for product installation shall not sub-contract the labor portion without written approval of the Project Manager
    4. Flooring contractor will be responsible for the proper product installation, including floor testing and preparation as specified by the manufacturer and job conditions.
    5. Flooring contractor shall provide to Cache County School District a written installation warranty that covers the completed installation to free from defects in workmanship for a period of 5 years after job completion..
D. Fire Test Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting Agency acceptable to authorities having jurisdiction.
E. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction and performance.
F. Installer Qualifications: Company specializing in installing carpet with minimum five years experience and approved by manufacturer.

1.06 FIELD CONDITIONS

A. Comply with CRI 104 - Standard for Installation of Commercial Carpet; Carpet and Rug Institute; 2015.Section 5, "Storage and Handling."
B. Store materials in area of installation for minimum period of 24 hours prior to installation.
C. Maintain the temperature of the installation site, carpet, and adhesive between a minimum temperature of 65 degrees F and a maximum temperature of 95 degrees F for 24 hours before installation. Do not begin the installation if the room or subfloor temperature is below 65 degrees F. The adhesive will not function properly when applied over an extremely cold surface. Relative humidity should not exceed 65 percent. Maintain these conditions for 24 hours prior to, during and 24 hours after installation.
D. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

E. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.
F. Ventilate installation area during installation and for 72 hours after installation.

1.07 WARRANTY

A. Provide 5-year written guarantee on installation by floor covering installer accompanied by written certification from carpet manufacturer verifying specified requirements have been met.
   1. Guarantee shall cover defects in workmanship and include statement that flooring installer shall, at no additional expense to Owner and upon written notice from Owner, promptly correct or replace improper work and material that may become apparent within 60 months after date of final completion.
   2. Installer shall complete corrective work within 15 days of receipt of Owner's written notice unless other arrangements are made in writing with Owner.
   3. Floor covering installer's Guarantee shall be in form given in Section 01 7800.
B. Provide carpet manufacturer's 10 year guarantee on floor covering including specific workmanship guarantees for delamination, edge raveling, fuzzing, piling, and other textural changes which can be controlled through proper manufacturing.
C. Lifetime Limited Commercial Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturers:
   1. Tarkett: www.tarkett.com.
   2. Mohawk: www.mohawk.com.
B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 CARPET

A. **Type FC1** Broadloom Roll Carpet: To be installed at all Classroom locations.
   1. Product: 11128 ColorKnit manufactured by Tarkett.
   2. Roll Dimensions: 105 feet by 6 feet (3200.40 cm by 182.88 cm).
   3. Backing: Powerbond Cushion.
   4. Color: Eucalyptus Leaf 30218.
   5. Critical Radiant Flux: Class I, when tested in accordance with ASTM E648 or NFPA 253.
   6. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
   7. Substitutions: See Section 01 6000 - Product Requirements.
B. **Type FC2** Broadloom Roll Carpet: To be installed at all Administration Areas, Media Center, and Corridors.
   1. Product: 11577 Corollary manufactured by Tarkett.
   2. Roll Dimensions: 105 feet by 6 feet (3200.40 cm by 182.88 cm).
   3. Secondary Backing: Powerbond Cushion.
   4. Color: Greenbuc 39409.
   5. Critical Radiant Flux: Class I, when tested in accordance with ASTM E648 or NFPA 253.
   6. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
   7. Substitutions: See Section 01 6000 - Product Requirements.
C. **Type FC3** Walk-Off Tile Carpet: To be direct-glued at all Entrance locations.

1. Product: Step Up II GT311 - Tuff Stuff II Collection, manufactured by Mohawk.
2. Carpet Tile Dimensions: 24 inches by 24 inches.
3. Backing: Nxt Walkoff.
4. Color: Cobalt 955.
5. Flammability: (ASTM E648 Class I) - Glue Down.
6. Static Propensity: (AATC 134) Under 3.5KV.
7. Smoke Density: (ASTM E662) Less than 450.

D. **Type FC4** Music Classroom Piano and Music Bar Pattern.
1. Custom carpet inlay for direct, on-site cut-in and glue-down; constructed from select colors of FC4 and FC5 product types.
2. Dimensions: Custom; refer to Drawings.
3. Product: Plexus Imaginations, manufactured by Tarkett.
   a. Color: White.
4. Backing: Powerbond Cushion.

E. **Type FC5** Music Classroom Piano and Music Bar Pattern.
1. Custom carpet inlay for direct, on-site cut-in and glue-down; constructed from select colors of listed FC4 and FC5 product types.
2. Dimensions: Custom; refer to Drawings.
3. Product: Plexus Colours IV 02875.
   a. Color: Dark Shadow 18552.
4. Backing: Powerbond Cushion.

2.03 BASE

A. **Type B1 -** Carpet Base: Same manufacturer, type, color and pattern, and face fiber characteristics as Carpet Type FC1, 4 inches (102 mm) high, manufactured in same color dye lot as carpet with exposed edges bound.
B. **Type B2** - Rubber Base: See Section 09 6500 - Resilient Base.

2.04 ACCESSORIES, CARPET

A. Subfloor Filler: Type recommended by carpet manufacturer.
B. Primer: Type recommended by flooring material manufacturer.
C. Resilient Transition Strips:
1. Manufacturers:
   a. Johnsonite, Inc: www.johnsonite.com.
   b. Roppe Corporation: www.roppe.com.
   c. Substitutions: See Section 01 6000 - Product Requirements.
2. Material: Polyvinyl chloride (PVC)
3. Carpet to Concrete: CTA-XX-P manufactured by Johnsonite, Inc.
4. Carpet to Homogenous Resilient Sheet: CTA-XX-A manufactured by Johnsonite, Inc.

D. Seam Adhesive: Recommended by carpet manufacturer.
E. Carpet Adhesive: Recommended by carpet manufacturer.

2.05 ACCESSORIES, ENTRANCE FLOORING

A. Sub-Floor Filler: White premix latex; type recommended by flooring manufacturer.
B. Primer: Latex primer; type recommended by flooring manufacturer.
C. Resilient Transition Strips:
1. Manufacturers:
   a. Johnsonite, Inc: www.johnsonite.com.
   b. Roppe Corporation: www.roppe.com.
   c. Substitutions: See Section 01 6000 - Product Requirements.

2. Entrance Flooring to Carpet: Polyvinyl chloride (PVC), 1 1/2 inch (38 mm) wide level transition for adjoining 1/4 inch (6 mm) and 5/16 inch (8 mm) carpet, 1/4 inch (6 mm) long snap-in stem with single flange vinyl track base.
   a. Product: CD-XX with Track CDB-00-A manufactured by Johnsonite, Inc.

D. Adhesives - General: Acceptable to carpet tile manufacturer, compatible with materials being adhered.

PART 3 EXECUTION

3.01 INSPECTION

A. Testing:
   1. Testing to be done by an Independent Testing Agency, refer to Section 01 4000.
   2. Test in accordance with ASTM F710.
   3. Test the concrete for alkalinity prior to beginning the installation. Test the concrete for surface pH at several locations. A reading below 5.0 or above 9.0 requires corrective measures. Follow manufacturer's recommendations on the correct method of neutralizing low or high pH.
   4. Test the concrete for moisture at several locations using anhydrous calcium chloride test kits. The moisture transmission rate must not exceed 5.0 lbs. per 1000 sq. ft. per 24 hours. Do not begin the installation if an unacceptable moisture level is detected. Do not use other methods of moisture testing as they are not reliable. If excessive moisture is present, the General Contractor, Architect and Owner must be advised and a decision made if the installation is to begin.

3.02 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesives to subfloor surfaces.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
D. Verify that required floor-mounted utilities are in correct location.

3.03 PREPARATION

A. The floor must be dry, free of dust, dirt, oil, grease, paint, wax, or any debris that could affect adhesion of the carpet modules to the floor.
B. Do not use sweeping compounds as they may leave oily deposits. The floor must be level and smooth. Depressions and cracks must be filled with a liquid latex additive patching compound and all protrusions leveled.
C. Concrete floors must be sealed with liquid latex recommended by manufacturer if dusting or powdering exists.
D. Apply latex primer as recommended by manufacturer.
E. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

3.04 INSTALLATION - GENERAL

A. Install carpet and cushion in accordance with manufacturer's instructions and CRI 104 (Commercial).
B. Verify carpet match before cutting to ensure minimal variation between dye lots.

C. Lay out carpet and locate seams in accordance with shop drawings.
   1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
   2. Do not locate seams perpendicular through door openings.
   3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
   4. Locate change of color or pattern between rooms under door centerline.
   5. Provide monolithic color, pattern, and texture match within any one area.
D. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

3.05 INSTALLATION, CARPET TILE AND ENTRANCE FLOORING

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install carpet tile in accordance with manufacturer's instructions.
C. Begin the installation by installing according to the carton number. Each module has directional arrows on the backing. Refer to Architect and Manufacturer for directional pattern.
D. Installation must begin at the intersection of two chalk lines. Installation must continue until completed in one quadrant, then proceed to an adjoining quadrant until all four quadrants are completed. Larger areas may require chalk lines bisecting the original four quadrants.
E. Install modules using the pyramid technique. This allows multiple alignment checks. If the edges do not align and the misalignment increases with progression of the installation, the source of the problem must be identified and corrected.
F. Slide modules into position to prevent yarn from being trapped between the modules. Trapped yarn will adversely affect the appearance of the installation and will cause alignment problems.
G. Modules must fit snugly, but not be compressed. Press the entire surface of the tile to ensure adhesion. Check for fit by measuring the length of ten full modules after installation. The measurement must not be less than, or exceed by more than 1/4 inch, the length of the modules being multiplied by ten. For example: if 24 inch by 24 inch modules are being installed, the measurement should be between 240 and 240 1/4 inches.
H. Cutting Techniques:
   1. Modules may be cut by measuring and cutting from the back using a straight edge. Care must be taken to assure the arrows are pointing in the correct direction.
   2. Modules may also be cut by letting them cove up the wall and cutting with a cushion back wall trimmer or similar tool. Do not compress.
I. Roll the entire installation with a 75 lb roller once it is completed.
J. Blend carpet from different cartons to ensure minimal variation in color match.
K. Trim carpet tile neatly at walls and around interruptions.
L. Complete installation of transition strips, concealing exposed edges.

3.06 DIRECT-GLUED CARPET

A. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.
B. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.
C. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.
D. Roll with appropriate roller for complete contact of adhesive to carpet backing.
E. Trim carpet neatly at walls and around interruptions.
F. Install carpet base according to manufacturer's instructions.

3.07 INSTALLATION ON RISERS

A. Install carpet according to manufacturer's instructions. Apply seam adhesive to all cut edges.
B. Install carpet with pile direction in the length of the riser.
C. Adhere carpet tight to risers.

3.08 CLEANING

A. Remove excess adhesive from floor and wall surfaces without damage.
B. Clean and vacuum carpet surfaces.

END OF SECTION 09 6800

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SECTION 09 7200

VINYL COATED FABRIC WALL COVERINGS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:
   1. Custom digital image wallcovering (VWC).
B. Related Sections include the following:
   1. Division 09 Section "Interior Painting" for primers, coatings, and paint for wall coverings.

1.02 SUBMITTALS

A. Samples for Verification: 8-1/2 inch by 11 inch section of wall covering from lot to be used for each type of wall covering indicated for each color, texture, and pattern required.
   1. With specified treatments applied.
B. Informational/Quality Assurance/Control Submittals:
   1. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
C. Closeout Submittals:
   1. Maintenance Data: For wall coverings to include in maintenance manuals.
   2. Receipt for extra materials.

1.03 QUALITY ASSURANCE

A. Qualifications of Installers: For actual cutting and installation of wall covering, use only thoroughly trained and experienced installers completely familiar with the installation recommendations of the manufacturer of the wall covering used; and completely familiar with the requirements of this Work.
B. Fire-Test-Response Characteristics: Provide wall coverings and adhesives with the following fire-test-response characteristics as determined by testing identical products applied with identical adhesives to substrates per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Surface-Burning Characteristics: As follows, per ASTM E 84:
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.
   2. Fire-Growth Contribution: No flash over and heat and smoke release according to NFPA 286.
C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation. At the beginning of the installation, prepare one wall (approximately 60 sq.ft.) as indicated by A/E for each finish required.
   1. Provide a mockup for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless A/E specifically approves such deviations in writing.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.04 PROJECT CONDITIONS

A. Environmental Limitations: Do not install wall coverings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
   1. Maintain a constant temperature of not less than 60 degrees F in installation areas for at least 10 days before and after installation.

B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

1.05 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Wall-Covering Material: Full-size units equal to 5 percent of amount of each type installed.

PART 2 PRODUCTS

2.01 DIGITAL IMAGING WALL COVERING

A. Manufacturers: Subject to compliance with requirements, provide product one of the following:
   1. Koroseal - Digital Lab: www.koroseal.com
   2. MDC - Digital Imaging: www.mdcwall.com
   3. Products of other manufacturers will be considered for acceptance provided they are equal or exceed the material requirements and functional qualities of the specified product. Requests for A/E's approval must be accompanied by the "Substitution Request Form" and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

B. Custom Digital Imaging Wall-Covering.
   1. Image to be provided by Architect.
   2. Digital wall-covering shall be printed on 53 inch/54 inch vinyl wall-covering substrate using piezo drop-on-demand technology incorporating a minimum of eight colors. Printed image shall be dried from both front and back using combinations of IR and platen heaters to prevent media distortion.
   3. Vinyl Wall-covering substrate: Through pigmented, mildew inhibitorized polyvinyl chloride, adhered to cotton, cotton/blend fabric backing, or a cellulose polyester non-woven backing. All materials shall be Cadmium and Mercury free, and shall confirm to the CFFA-W-101-B.
      a. Weight: minimum 13 ounces per square yard.
      b. Backing Weight: Minimum 2 ounces per square yard.
   4. Pattern, Image and Color: As indicated in List of Finishes.

2.02 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application, as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Division 09 Section "Interior Painting" and recommended in writing by wall-covering manufacturer for intended substrate.
C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.
B. Clean substrates of substances that could impair wall covering's bond, including mold, mildew, oil, grease, incompatible primers, dirt, and dust.
C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
    1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
    2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity.
    3. Allow new plaster to cure. Treat areas of high alkalinity.
        a. Moisture Content: Maximum of 5 percent when tested with an electronic moisture meter.
        b. Masonry Surfaces: Refer to Division 09 Section “Veneer Plaster” and above recommendations.
    4. Painted Surfaces: Treat areas susceptible to pigment bleeding.
D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.03 WALL LINER INSTALLATION

A. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.
    1. Provide wall liner, where required to correct inadequate substrate conditions with no gaps or overlaps, where required by wall covering manufacturer.

3.04 INSTALLATION

A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
C. Install strips in same order as cut from roll.
    1. Install reversing every other strip, where recommended by wall covering manufacturer.

2. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
3. Match pattern 72 inches above the finish floor.
4. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
5. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
6. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

D. Digital Imaging Panels: Install per Manufacturer's written instructions using the surface mounted two-component cleat assembly. All fasteners shall be hidden from view.
   1. Provide appropriate fastener for mounting cleats into concrete masonry or drywall and metal stud walls.

3.05 CLEANING

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
B. Use cleaning methods recommended in writing by wall-covering manufacturer.
C. Replace strips that cannot be cleaned.
D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 7200

SECTION 09 8405

ACOUSTICAL PANELS AND BAFFLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Acoustic Room Component work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Sound-absorbing PET felt solid core acoustical wall panels.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Casework.
B. Section 09 5100 - Acoustical Ceilings: Suspension system for ceiling diffusers.
C. Section 09 7250 - Acoustical Wall Coverings.
D. Section 09 9123 - Interior Painting.

1.03 REFERENCE STANDARDS

A. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

1.04 ACTION SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for each type of panel edge, core material, and mounting indicated.
C. Shop Drawings: Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Include elevations showing panel sizes and direction. Indicate panel edge and core materials.
D. Selection Samples: Manufacturer's color charts for fabric covering, indicating full range of fabrics, colors, thickness, and patterns available.
E. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work:
    1. Panel Edge: 12-inch-(300mm-) long Sample showing edge profile, corner, and finish.
    2. Core Material: 12-inch-(300mm-) beveled edge sample showing each corner.
    3. Mounting Device: Full-size Sample.
    4. Sample Panels: No larger than 36 by 36 inches (914 by 914 mm). Show joints and mounting methods.
F. Product Certificates: For each type of acoustical wall panel, signed by product manufacturer.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show intersections with wall base, doors, electrical outlets and switches, thermostats, lighting fixtures, air outlets and inlets, access panels, and other adjacent work.
B. Qualification Data: For fabricator and testing agency.
C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of Sound Absorbing PET Felt Acoustical Wall Panels.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: PET Wall Panels to include in maintenance manuals. Include written cleaning and stain-removal recommendations.

B. Warranty: Special warranty specified in this Section.

1.07 MAINTENANCE MATERIALS SUBMITTALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sound Absorbing PET Felt Acoustical Wall Panel V-Groove: Full-size units equal to 5 percent of amount installed, but no fewer than 5 attachment devices.

1.08 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
B. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.
C. Fire-Test-Response Characteristics: Provide Sound Absorbing PET Felt Acoustical Wall Slat with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction and in accordance with 803.6.2 of 2016 IBC.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.
D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrications and installation.
   1. Install mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
   2. Install mockup of typical wall area as shown on Drawings.
      a. Include intersection at **wall and ceiling corner and door opening**.
E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination.”

1.09 DELIVERY, STORAGE, AND HANDLING

A. Comply with Felt panel wall panel manufacturers’ written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place and adequate air circulation.
C. Protect panel edges from damage.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install Sound Absorbing PET Felt Acoustical Wall Panels until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at levels indicated for Project when occupied for its intended use.
B. Lighting: Do not install PET Wall and Ceiling Panels until a lighting level of not less than 50 fc (538 lux) is provided on surfaces to receive Sound Absorbing PET Felt Acoustical Wall Panels.
C. Air-Quality Limitations: Keep Sound Absorbing PET Felt Acoustical Wall Slat from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

D. Air-Quality Limitations: Keep Sound Absorbing PET Felt Acoustical Wall Slat from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of PET Wall and Ceiling Panels that fail in performance, materials, or workmanship within specified warranty period.
   1. Failures in materials include but are not limited to, fabric sagging, distorting, or releasing from panel edge; or warping of core.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer:
   1. ONNiT Systems: www.onnitsystems.com.
B. Alternative manufacturers may be considered under approval of Architect. For substitutions: See Section 01 6000 - Product Requirements.

2.02 PRODUCTS

A. Sound-Absorbing 100% PET Felt Tackable Acoustical Wall Panels.
   1. Surface Texture: Smooth.
   2. Surface Finish: Smooth.
   3. Color: As selected by Architect from manufacturer's full line of offerings.
   4. Shapes: As indicated on drawings.
   5. Dimensions: Standard Panel, 4 feet by 8 feet, 4 feet by 9 feet.
   6. Thickness: 1/2 inch (12.7 mm).
   7. Density: Min 1900g/sqm – 2400g /sqm (approx. 14 pcf).
   8. Edge Detail: Bevel.
   9. Flame Spread: (ASTM E 84) Class A.
   10. Noise Reduction Coefficient (NRC): ASTM C423; 0.4-.90, depending on thickness and air gap.
   11. Trim: Aluminum -- exterior panel only.
   12. Attachment System: Direct-glue mount.
B. Basis of Design Product: V-Groove Sound Absorbing PET Felt Acoustical Wall Panels.
C. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FABRICATION

A. Fabric Wrapped, General: Fabricate panels to sizes and configurations indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, edge straightness, overall length and width, squareness from corner to corner, chords, radii, and diameters.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine panels, substrates, clocking, and conditions, with installer present, for compliance with requirement, installation tolerances, and other conditions affecting performance of wall panels.

3.02 INSTALLATION

A. Install acoustical panels in locations indicated, following installation recommendations of panel manufacturer. Align panels accurately, with vertical surfaces and edges plumb and top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and penetrations.
   1. Cut units to be at least 50 percent of unit width, with facing material extended over cut edge to match uncut edge. Scribe acoustical wall panels to fit adjacent work. Butt joints tightly.
B. Comply with PET Wall and Ceiling Panels manufacturer’s written instruction for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.
C. Match and level pattern and grain among adjacent panels.
D. Installation Tolerances: As follows:
   1. Variation from Level and Plumb: Plus or minus 1/16 inch (1.6mm).
   2. Variation of Panel Joints from Hairline: Not more than 1/16 inch (1.6mm) wide.

3.03 CLEANING

A. Remove pills and and extraneous materials.
B. Clean panels all panels (if needed) on completion of installation, to remove dust and other foreign materials according to manufacturer’s written instructions.

3.04 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacture and installer, to ensure that PET Wall and Ceiling Panels are without damage or deterioration at time of Substantial Completion.
B. Replace PET Wall and Ceiling Panels that cannot be cleaned and repaired in a manner approved by Architect, before time of Substantial Completion.
C. Suspend ceiling baffles at locations and heights indicated.
D. Install panels to construction tolerances of plus or minus 1/16 inch for the following:

3.05 CLEANING

A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.
B. Remove surplus materials, trimmed portions of panels, and debris resulting from installation.

3.06 PROTECTION

A. Provide protection of installed acoustical panels until completion of the work.
B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

SECTION 09 9123

INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Interior Painting work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Surface preparation of substrates as required for acceptance of painting, including high pressure washing, abrasive blasting, cleaning, small crack repair, patching, and caulking.
C. Field application of paints.
D. Materials for backpriming woodwork.
E. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
    1. If a surface, material, or item is not specifically mentioned, paint in the same manner as similar surfaces, materials, or items, regardless of whether colors are indicated or not.
    2. Finish surfaces behind movable equipment and furnishings the same as similar exposed surfaces.
    3. Finish surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of the permanent item.
    4. Finish semi-exposed structure, miscellaneous pipes, conduit, ducts, etc. visible through finished ceiling elements.
    5. Finish back sides of access panels and removable and hinged covers to match exposed surfaces.
    6. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
    7. Elevator pit ladders.
    8. Prime surfaces to receive wall coverings.
F. Do Not Paint or Finish the Following Items:
    1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
    2. Items indicated to receive other finishes.
    3. Tile Backer Board
    4. Items indicated to remain unfinished.
    5. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
    6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
        a. Unless indicated
    7. Marble, granite, slate, and other natural stones.
    8. Floors, unless specifically indicated.
    9. Ceramic and other tiles.
    10. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
    11. Glass.
    12. Concrete masonry units in utility, mechanical, and electrical spaces.
    13. Acoustical materials, unless specifically indicated.
    14. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.
B. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523, a matte flat finish.
C. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.
D. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.
E. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.
F. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
G. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.03 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
E. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).
F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
G. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
H. SSPC-SP 2 - Hand Tool Cleaning; 2018.
I. SSPC-SP 3 - Power Tool Cleaning; 2018.
J. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide complete list of products to be used, with the following information for each:
    1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
    2. Cross-reference to specified paint system(s) product is to be used in; include description of each system. Use same designations indicated on Drawings and in schedules.
    3. Manufacturer's installation instructions.
    4. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.
    5. Product characteristics.
    6. Primer requirements and finish specification.
    7. Storage and handling requirements and recommendations.
    8. Application methods.
    9. Cautions.
C. Selection Samples: Submit a complete set of color chips that represent the full range (including premium) of manufacturer's color samples available.
    1. Allow 30 days for approval process, after receipt of complete samples by Architect.

2. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, factory finished metals, wood doors, and casework, have been approved.
3. Where sheen is specified, submit samples in only that sheen.
4. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
5. Within a reasonable amount of time after all color related submittals have been reviewed and accepted, the Architect will issue the "Color Schedule" for the project which will include all required paint color selections for the Contractors use.

D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Certification: By manufacturer that paints and finishes comply with VOC limits specified.

F. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Data: Submit coating maintenance manual including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color, type, texture, and room locations in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. This Contractor shall have a minimum of five (5) years proven satisfactory experience and shall show proof before commencement of work that he will maintain a qualified crew of painters throughout the duration of the work. Contractor shall provide a list of the last three comparable jobs including, name and location, project manager, start/completion dates and value of painting work.

B. Material Safety Data Sheets: At project site maintain file of MSDS sheets for each product used; become familiar with and follow manufacturer's stated application and safety requirements.

C. All surfaces requiring painting/coating shall be inspected by the Painting/Coating Manufacturer's Product Representative who shall notify the Architect and General Contractor in writing of any defects or problems, prior to commencing painting work, or after the prime coat shows defects in the substrate. The Manufacturer's Product Representative shall provide a written certification of all surfaces and conditions for paint or coating system application as well as on site supervision, inspection and approval of the application.

D. The painting contractor shall receive written confirmation of the specific surface preparation procedures and primers used for all fabricated steel items from the fabricator/supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

E. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

F. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

1.07 MOCK-UP

A. See Section 01 4300 - Quality Assurance, for general requirements for mock-up.
B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
C. Locate where directed by Architect.
D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer’s label with the following information:
   1. Product name and type (description).
   2. Batch date.
   3. Color number.
   4. VOC content.
   5. Environmental handling requirements.
   6. Surface preparation requirements.
   7. Application instructions.
B. Paint Materials: Store materials not in use in tightly covered containers in well-ventilated areas at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.09 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F (10 and 35 degrees C).
B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.10 GUARANTEE

A. This Contractor shall guarantee his work for a period of One (1) years from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated from one of the following:
   1. Sherwin-Williams
   2. PPG Paints.
B. Provide paints and finishes from the same manufacturer to the greatest extent possible.
C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Material Compatibility:
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
   6. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
B. VOC Content: Utah Administrative Code R307-361 Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Flat Paints and Coatings: 50 g/L.
   2. Non flat Paints and Coatings: 100 g/L.
   3. Dry-Fog Coatings: 150 g/L.
   4. Primers, Sealers, and Undercoaters: 100 g/L.
   5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
   6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
   7. Pretreatment Wash Primers: 420 g/L.
   8. Floor Coatings Foot Traffic: 100 g/L.
   9. Floor Coatings High Performance: 250 g/L.
   10. Shellacs, Clear: 730 g/L.
   11. Shellacs, Pigmented: 550 g/L.
   12. Wood Coatings: 275 g/L.
C. Flammability: Comply with applicable code for surface burning characteristics.
D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
E. Colors: To be selected from manufacturer's full range of available colors.

1. Selection to be made by Architect after award of contract.
2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
5. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.03 PAINT SYSTEMS - INTERIOR

A. NOTE:
   1. Refer to Section 07 1900 - Exterior Water Repellents and Graffiti Resistant Sealers for Exterior Sealers.
   2. Refer to Section 09 9724 - Sealers - Interior Concrete, Precast and Masonry Sealers for Interior Sealers.
   3. (Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.)

B. CMU - Walls: Epoxy, semi-gloss finish.
   For: WP3 and Stage.
   1. Primer:
      a. Product: S/W Loxon Block Surfacer.
      b. Product: PPG 4-100XI Perma Create Concrete Masonry Surfacer/Filler.
   2. 1st coat:
      a. Product: S/W Pro Industrial Pre-Catalyzed Water-Based Epoxy.
      b. Product: PPG Pitt Glaze WB1 Interior Pre-Catalyzed Semi-Gloss (16-510).
   3. 2nd coat:
      a. Product: S/W Pro Industrial Pre-Catalyzed Water-Based Epoxy.
      b. Product: PPG Pitt Glaze WB1 Interior Pre-Catalyzed Semi-Gloss (16-510).

C. CP1 Ceilings: Epoxy, semi-gloss finish.
   For: Restroom Ceilings, Kitchen, Cafeteria.
   1. Primer:
      a. Product: S/W Loxon Block Surfacer.
      b. Product: PPG-4-100XI Perma-Crete Concrete Masonry Surface/Filler.
   2. 1st coat:
      a. Product: S/W Pro Industrial Pre-Catalyzed Water-Based Epoxy.
      b. Product: PPG Pitt Glaze WB1 Interior Pre-Catalyzed Semi-Gloss (16-510).
   3. 2nd coat:
      a. Product: S/W Pro Industrial Pre-catalyzed Water-Based Epoxy.
      b. Product: PPG Pitt Glaze WB1 Interior Pre-Catalyzed Semi-Gloss (16-510).

D. WP1 Gypsum - Walls: Acrylic, eggshell finish
   For: Classrooms, offices, hallways, breakrooms, etc.
   Gypsum walls under wall systems - (2) coats primer only.
   1. Primer:
      a. Product: S/W ProMar 200 Zero VOC Interior Latex Primer.
      b. Product: PPG 6-4900XI Speed-hide Zero VOC Interior High Solids Latex Primer.
   2. 1st coat:
      a. Product: S/W ProMar 200 Zero VOC HP Latex Eg-shel B20 Series.
      b. Product: PPG Manor Hall Interior Paint 82-410 Series.
   3. 2nd coat:
      a. Product: ProMar 200 Zero VOC HP Latex Eg-shel B20 Series
      b. Product: PPG Manor Hall Interior Paint 82-410 Series

E. WP4 - Ferrous Metal: Epoxy Semi-Gloss Finish
   HM Doors, Frames and miscellaneous metals
   1. Primer:
      a. Product: S/W Pro industrial Pro-Cryl Universal Metal Primer
      b. Product: PPG 4020 Pitt-Tech Interior/Exterior Primer Finish DTM Industrial Enamel
   2. 1st coat:
      a. Product: S/W Pro Industrial Pre-Catalyzed Water-Based Epoxy
      b. Product: PPG Pitt Glaze WB1 Interior Pre-Catalyzed Semi-Gloss (16-510)
   3. 2nd coat:
      a. Product: S/W Pro Industrial Pre-Catalyzed Water-Based Epoxy
      b. Product: PPG Pitt Glaze WB1 Interior Pre-Catalyzed Semi-Gloss (16-510)

F. Ferrous Metal: Semi-Gloss Finish
   Hand Rails
   1. Primer:
      a. Product: S/W Recoatable Epoxy Primer
      b. Product: PPG Americoat 385 Epoxy Primer
   2. 1st coat:
      a. Product: S/W Hi Solids Polyurethane B65 Series
      b. Product: PPG Pitthane Ultra Gloss 95-812
   3. 2nd coat:
      a. Product: S/W Hi Solids Polyurethane B65 Series
      b. Product: PPG Pitthane Ultra Gloss 95-812

G. Non-Ferrous Metal
   1. Primer:
      a. Product: S/W Pro industrial Pro-Cryl Universal Metal Primer
      b. Product: PPG 4020 Pitt-Tech Plus Interior/Exterior Primer Finish DTM Industrial Enamel
   2. 1st coat:
      a. Product: S/W Pro Industrial Acrylic Semi-gloss
      b. Product: PPG 4216 Pitt Tech Plus DTM Acrylic Semi-Gloss Finish
   3. 2nd coat:
      a. Product: S/W Pro Industrial Acrylic Semi-gloss
      b. Product: PPG 4216 Pitt Tech Plus DTM Acrylic Semi-Gloss Finish

H. CPS - Exposed Ceilings: Acrylic Dryfall Flat Finish
   To include: Structural Steel, Metal Deck, Pipes, Ducts, Catwalks, Ladders, Railings, Etc.
   1. Primer:
      a. Product: S/W Pro industrial Pro-Cryl Universal Metal Primer
      b. Product: PPG 4020 Pitt-Tech Plus Interior/Exterior Primer Finish DTM Industrial Enamel
   2. 1st coat:
      a. Product: S/W Pro Industrial Waterborne Acrylic Dryfall
      b. Product: PPG 6-725XI Speed-hide Supertech Interior Flat White Dryfall
   3. 2nd coat:
      a. Product: S/W Pro Industrial Waterborne Acrylic Dryfall
      b. Product: PPG 6-725XI Speed-hide Supertech Interior Flat White Dryfall

I. Acoustic Panels: Acrylic Dryfall, flat finish
   For: Cementitious wood fiber acoustical panels
   1. 1st coat:
      a. Product: S/W Pro Industrial Waterborne Acrylic Dryfall
      b. Product: PPG 6-725XI Speed-hide Supertech Interior Flat White Dryfall
   2. 2nd coat:

a. Product: S/W Pro Industrial Waterborne Acrylic Dryfall
b. Product: PPG 6-725XI Speed-hide Supertech Interior Flat White Dryfall

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
B. Patching Material: Latex filler.
C. Fastener Head Cover Material: Latex filler.

2.05 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been adequately prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
   1. Report, in writing, conditions that may affect application, appearance, or performance of paint.
D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
   1. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
   2. Plaster Substrates: Verify that plaster is fully cured.
   3. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
F. Test shop-applied primer for compatibility with subsequent cover materials.
G. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Plaster and Stucco: 12 percent.
   3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
   5. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.
E. Concrete:
    1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
    2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
    3. Clean concrete according to ASTM D4258. Allow to dry.
    4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
F. Masonry:
    1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
    2. Prepare surface as recommended by top coat manufacturer.
    3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.
G. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
J. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
K. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
L. Galvanized Surfaces:
    1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
    2. Prepare surface according to SSPC-SP 2.
M. Ferrous Metal:
    1. Solvent clean according to SSPC-SP 1.
    2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
    3. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
        a. SSPC-SP 2, "Hand Tool Cleaning."
        b. SSPC-SP 3, "Power Tool Cleaning."
        c. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
N. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
O. Aluminum Substrates: Remove loose surface oxidation.
P. Wood Surfaces to Receive Opaque Finish:
    1. Wipe off dust and grit prior to priming.

2. Seal knots, pitch streaks, and sappy sections with sealer.
3. Fill nail holes and cracks after primer has dried;
4. Sand between coats.
5. Back prime concealed surfaces before installation.

Q. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
R. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
S. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
T. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
   1. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
   2. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
G. Sand wood and metal surfaces lightly between coats to achieve required finish.
H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4300 - Quality Assurance, for general requirements for field inspection.
B. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.06 PROTECTION

A. Protect finishes until completion of project.
B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 9123

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SECTION 09 9724

SEALERS - INTERIOR CONCRETE, PRECAST AND MASONRY SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Interior Concrete and Masonry Finish work as is indicated on the drawings and/or specified herein including, but not limited to, the following items.
B. Sealer applied to interior honed masonry and concrete walls.
C. Sealer applied to new interior pre-cast architectural concrete (stair tread and landings).
D. Surface preparation.
E. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders

1.02 RELATED REQUIREMENTS

A. Section 03 4500 - Pre-cast Architectural Concrete.
B. Section 04 2731 - Reinforced Unit Masonry: Honed masonry.
C. Section 07 9200 - Joint Sealants.

1.03 REFERENCE STANDARDS

A. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2010.
B. ASTM C779/C779M - Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces; 2010.
C. ASTM C805/C805M - Standard Test Method for Rebound Number of Hardened Concrete; 2008.
D. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007e1.
E. ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test; 2009e2.
F. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005.
G. ASTM D5095 - Standard Test Method for Determination of the Nonvolatile Content in Silanes, Siloxanes, and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect andCache County School District .

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.
C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Sealer Material: Two gallons of the type installed.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by the manufacturer.
C. Cache County School District reserves the right to provide continuous independent inspection of surface preparation and application of sealer.

1.07 MOCK-UP

A. Masonry Walls: Prepare a representative surface 36 x 36 inch in size of Sealed Masonry Wall using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
B. Concrete Floors: Prepare a representative surface 72 x 72 inch in size of Dyed and Sealed Concrete Floor using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
   1. Mockup shall be dyed and densified by the individual workers who will actually be performing the Work.
   2. Obtain written approval of the mockup.
C. Locate where directed.
D. Mockup may remain as part of the Work, if undisturbed at time of Substantial Completion at the discretion of the Architect.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.
B. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.09 FIELD CONDITIONS

A. Maintain ambient temperature of between 50 and 90 degrees F (10 and 32 degrees C) during application and at least 48 hours after application.
B. Precautions shall be taken to avoid damage or contamination of any surfaces near the work zone. Protect completed dye work from moisture or contamination.

1.10 WARRANTY

A. Provide 5 year written guarantee on installation by sealer installer accompanied by written certification from Sealer Manufacturer verifying Manufacturer's installation requirements have been met. Guarantee shall cover defects in workmanship and include statement that sealer installer shall, at no additional expense to Owner and upon written notice from Owner, promptly correct or replace improper work and material that may become apparent within 60 months after date of final completion. Installer shall complete corrective work within 15 days of receipt of Owner's written notice unless other arrangements are made in writing with Owner. Installer's Guarantee shall be in form given in Section 01 7800.

B. Manufacturer shall provide a writteen warranty that warrants respective products applied in accordance with manufacturer's specifications for a period of 5 years from date of Substantial Completion, against water intrusion due to material failure. When notified of such conditions, in writing, by the Owner, the manufacturer shall provide materials, and the applicator shall provide the labor to correct said deficiencies promptly and without inconvenience or cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

A. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
         1) Opaque, Flat: 50 g/L, maximum.
         2) Opaque, Nonflat: 150 g/L, maximum.
         3) Opaque, High Gloss: 250 g/L, maximum.
         4) Varnishes: 350 g/L, maximum.
      c. Architectural coatings VOC limits of State in which the project is located.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

B. Chemical Content: The following compounds are prohibited:
   1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
   2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate., dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

C. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

D. Accessory Materials: Materials not specifically indicated but required to achieve the finishes specified; commercial quality.

2.02 INTERIOR MASONRY AND PRE-CAST ARCHITECTURAL CONCRETE SEALER

A. Low Sheen Sealer
   1. Manufacturers:
      a. Okon, Inc.; Product - "OKON S-40": www.okoninc.com.
      b. BASF Building Systems; Product - MasterProtect H 185: www.buildingsystems.basf.com.
      c. Evonik Industries (formerly Degussa); Product - "Protectosil Aqua-trete SG": www.evonik.com.
      d. Sherwin-Williams Company; Loxon 7 Percent Siloxane, with VOC of Zero g/L: www.sherwin-williams.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify joint sealants are installed and cured.
C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of sealer.
    1. Unit Masonry: Below 12 percent.
    2. Concrete: Below 8 percent.

3.02 PREPARATION

A. Protection of Adjacent Work:
    1. Protect adjacent surfaces not intended to receive sealers.
B. Prepare surfaces to be coated as recommended by manufacturer for best results.
C. Do not start work until masonry mortar substrate or concrete is cured a minimum of 60 days.
D. Remove loose particles and foreign matter.
E. Remove oil and foreign substances with a chemical solvent that will not affect sealer.
F. Scrub and rinse surfaces with water and let dry.
G. Allow surfaces to dry completely to degree recommended by manufacturer before starting coating work.

3.03 MASONRY AND CONCRETE SEALER APPLICATION

A. Apply sealer in accordance with manufacturer's instructions, using procedures and application methods recommended for best results.
B. Apply at rate recommended by manufacturer, continuously over entire surface.

3.04 CLEANING AND PROTECTION

A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
B. At the end of each workday, remove empty cans, rags, rubbish, and other discarded sealer materials from site.
C. Protect other work against damaged. Correct damage by cleaning, repairing or replacing, and repainting as approved by Architect.
D. Provide "Wet Paint" signs to protect newly sealed finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
E. At completion of construction activities of other trades, touch up and restore damaged or defaced surfaces.

END OF SECTION 09 9724

SECTION 10 1100

VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Visual Display Board work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Markerboards.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
B. Section 10 1124 - Tackable Wall Systems: Brackets for display board mounting.

1.03 REFERENCE STANDARDS

A. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
D. Samples: Two, 2 by 2 inches in size illustrating materials and finish, color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surfacing, and trim.
E. Test Reports: Show compliance to specified surface burning characteristics requirements.
F. Manufacturer's printed installation instructions.
G. Manufacturer's Qualification Statement.
H. Maintenance Data: Include data on regular cleaning and stain removal .

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Note that all visual display boards must be compatible with Section 10 1124 - Tackable Wall System.
B. ADP Lemco, Inc: www.adplemco.com.
C. Claridge Products and Equipment, Inc: www.claridgeproducts.com.

D. MooreCo, Inc: www.moorecoinc.com.
E. Nelson Adams NACO: www.nelsonadamsnaco.com.
F. Polyvision Corporation: www.polyvision.com.
G. Platinum Visual System: www.pvsusa.com.
H. AJW Architectural Products: https://ajw.com.
I. Substitutions: See Section 01 6000 - Product Requirements.

2.02 VISUAL DISPLAY UNITS

A. Fixed Markerboards: Porcelain enamel on steel, laminated to core.
   1. Color: White.
   2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch.24 gauge, 0.0239 inch
   3. Core: Medium Density Fiberboard, 1/2 inch thick, laminated to face sheet.
   4. Backing: Aluminum foil, laminated to core.
   5. Sizes: 4 feet by 10 feet; 4 feet by 8 feet; 4 feet by 6 feet; 4 feet by 4 feet.
   6. Frame: Extruded aluminum, with concealed fasteners.
   7. Frame Trim: 5/8 inch (16 mm) exposed face.
   8. Frame Finish: Satin Anodized natural.
   9. Accessories: Provide map rail, flag holder, and marker tray.

2.03 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
B. Medium Density Fiberboard: ASTM C 208, cellulosic fiber board.
C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
D. Adhesives: Type used by manufacturer.
E. Adhesives: Type used by manufacturer.

2.04 ACCESSORIES

A. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
B. Marker Tray: Aluminum, manufacturer's standard profile one piece full length of chalkboard, closed ends; concealed fasteners, same finish as frame.
C. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.
B. Install with top of marker tray at 30 inches above finished floor.
C. Secure units level and plumb.
D. Butt Joints: Install with tight hairline joints.

3.03 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.
B. Remove temporary protective cover at Date of Substantial Completion.

3.04 SCHEDULE - REFER TO DRAWINGS

END OF SECTION 10 1100

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SECTION 10 1400

SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Building Signage work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Interior signage.
   1. Room signage.
   2. Restroom signage.
   3. Evacuation map signage.
   4. Safety signage.
C. Building identification signage.
D. Dedication plaque.
E. Site signage.
F. Do not include sales tax, refer to "Notice to Contractors".

1.02 RELATED REQUIREMENTS

A. Division 22 - Identification for Plumbing Piping and Equipment.
B. Division 26 - Identification for Electrical Systems.
C. Division 26 - Exit signs required by code.

1.03 PRICE AND PAYMENT PROCEDURES

A. See Section 01 2100 - Allowances: Cash allowance for Marquee signage.

1.04 REFERENCE STANDARDS

A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2003.
B. ATBCB ADAAG - Americans with Disabilities Act Accessibility Guidelines; 2002.
C. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2010.
D. ASTM D 1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2010.
E. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.
F. UL 94 - Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing; current edition.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.

2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 1 month prior to start of fabrication; submit preliminary schedule.
3. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit one sample of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
F. Verification Samples: Submit samples showing colors specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor.
C. Store tape adhesive at normal room temperature.

1.08 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.

1.09 GUARANTEE

A. This Contractor shall guarantee his work for a period of 1 year from date of Substantial Completion. Guarantee shall be in form found in Section 01 7800.
B. Manufacturer shall provide 1 year warranty against material and manufacturing defects.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Acrylic Signage:
   1. Acrylic signs to consist of a back panel and raised letters.
      a. Back Panel:
         1) Panel Thickness: .25 inch.
         2) Color: As selected by Architect from manufacturer's full line of colors.
      b. Raised Letters:
         1) Panel thickness: 0.0312 inch (0.8 mm).
         2) Finish: Matte non-glare.
         3) Color: As selected by Architect from manufacturer's full line of colors.
         4) Font: Helvetica.
      c. Braille:
         1) Finish: Matte non-glare.
         2) Color: As selected by Architect from manufacturer's full line of colors.
         3) Type: Grade II Braille.
      d. Corners: Square.
      e. Mounting: Tape adhesive - 3M RP45 VHB Tape.
         1) Glass Mounting: Provide graphic film on glass same size as sign to obscure mounting tape from opposite side. Gerber 220 series graphic film or equal.

f. Acceptable Acrylic Manufacturer: Rowmark; www.rowmark.com.

2. Signage Types:
   a. Room Sign, Changeable:
      1) Text Placement: As indicated on drawings.
      2) Size: 8 inches (203 mm) wide
      3) Integral window: As indicated on drawings.
      4) Context of Text: Refer to Signage Plan.
   b. Room Sign, Static:
      1) Text Placement: As indicated on drawings.
      2) Size: As indicated on drawings.
      3) Context of Text: Refer to Signage Plan.
   c. Restroom Sign:
      1) Text/Pictogram Placement: As indicated on drawings.
      2) Sizes: As indicated on drawings.
      3) Context of Text/Pictograms: Refer to Signage Plan.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BUILDING IDENTIFICATION LETTERS

A. General:
   1. Metal shall be free of all porosity and with sharp corners, flat faces, and accurate profiles.
   2. Remove burrs and rough spots.
   3. Belt polish all faces to uniform high luster finish.
   4. Sides shall be filed smooth with all tool marks removed by fine abrasive grain air blasting.
   5. Each letter shall be cleaned ultrasonically in a special de-greasing bath using high frequency sound waves.
B. Material:
   1. Aluminum alloy 514.
C. Letters:
   1. Font: "**Century Gothic Font."**
   2. Sizes: on Building.
      a. Name of school to be determind at a later date. Contractor to coordinate with Architect. Refer to exterior building elevations.
      b. "ELEMENTARY SCHOOL": 8 inches (203 mm) high by 1 inch (25 mm) deep.
D. Finish:
   1. As selected by architect from full line of finishes.
E. Mounting Hardware:
   1. Stud mount with 1/2 inch (13 mm) standoff.
F. Context of Text:
   1. Verify verbiage at time of shop drawing submittal. Contractor shall coordinate with Owner/Architect. Changes made by the Owner/Architect during submittal process shall Not be grounds for Change Order or Increase in Price.
   2. "NAME OF SCHOOL / ELEMENTARY SCHOOL"

2.03 DEDICATION PLAQUE

A. General:
   1. Provide unit free of pits, scale, sand, holes, and other defects, with specified raised letters, numbers, and characters.
   2. Hand tool and buff to provide clean, sharp figures with bright finish.
B. Size: 36 inches (915 mm) wide by 24 inches (610 mm) high, verify with Architect
C. Material:
   1. Aluminum alloy 5052, 3/8 inch (9.5 mm) thick.

2. Conform to industry standards for metal.

D. Letters:
   1. Style: Raised, font to be selected by Architect.
   2. Sizes: As selected by Manufacturer and approved by Architect.
   3. Finish: Satin polished.
E. Border: Single line bevel.
F. Background:
   1. Texture: Leatherette.
   2. Color: As selected by Architect from Manufacturer's full color line.
G. Finish: Two (2) coats of clear metal lacquer, and then finished with protective coating.
H. Mounting: Bosses on back to be drilled and tapped for threaded stud for a concealed mounting.
I. Context of Text:
   1. Exact verbiage and design will be supplied at time of shop drawing submittal. Contractor shall coordinate with Owner/Architect. Changes made by the Owner/Architect during submittal process shall Not be grounds for Change Order or Increase in Price.

2.04 SITE SIGNAGE

A. General:
   1. All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
B. Materials:
   1. Exterior Steel Panels:
      a. Panel Construction: 16 gauge electro-galvanized paintlock steel, ASTM A 591.
      b. Corner Condition: Round 1/2 inch (13 mm) diameter corner.
      c. Mounting: Refer to drawings.
C. Signage Types:
   1. ADA Signage and Parking Signage with Pictograms:
      a. Text/Pictogram Placement: Centered.
      b. Size: Varies, refer to drawings.
      c. Context of Text/Pictograms: Exact verbiage/pictograms will be supplied at time of shop drawing submittal. Contractor shall coordinate with Owner/Architect.
D. Finishes:
   1. Panel: One (1) coat of metal primer and Two (2) coats of synthetic automotive enamel.
      a. Color: Blue.
   2. Text and Graphics: Two (2) coats of bulletin paint.
      a. Font: ADA approved font as selected by Architect from manufacturer's full range.
      b. Color: White.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Complete all finishing operations, including painting, before beginning installation of signage systems.
C. Surfaces shall be dry and free from dirt, grease and loose paint.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install neatly, with horizontal edges level.

C. Locate signs where indicated by Owner/Architect.
D. Protect from damage until Substantial Completion; repair or replace damage items.

3.03 SCHEDULE - REFER TO DRAWINGS

END OF SECTION 10 1400

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SECTION 10 2114

PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Phenolic Toilet Compartment work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Sightless (privacy option) phenolic toilet compartments.
C. Hardware and structural accessories.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking and supports.
B. Section 09 2116 - Gypsum Board Assemblies: Concealed steel support members.
C. Section 10 2800 - Toilet, Bath, and Utility Accessories.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
C. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2018).
D. ASTM D2197 - Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion; 2013.
E. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2010).
F. ASTM D6117 - Standard Test Methods for Mechanical Fasteners in Plastic Lumber and Shapes; 2016.
G. ASTM D6578 - Standard Practice for Determination of Graffiti Resistance; 2013.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
I. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
K. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.
B. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.
C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
D. Samples: Submit two samples of partition panels, 12 inches by 12 inches in size illustrating panel finish, color, and sheen.
E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.06 DELIVERY, STORAGE AND PROTECTION

A. Deliver materials in manufacturer's original packaging to protect from damage.
B. Store materials in manufacturer's original packaging in accordance with manufacturer's instructions. Store materials indoors, protected from the elements and construction hazards.
C. Handle materials in a manner that will protect the finished product.

1.07 WARRANTY

A. This Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be in form found in Section 01 7800.
B. Provide manufacturer's Twenty-Five (25) year written limited warranty on its Panels, Pilasters and Doors, against chipping, breakage, corrosion, delamination and defects in workmanship; to be replaced without charge excluding labor.
C. Provide manufacturer's Ten (10) year written limited warranty on all Cast Stainless Steel Hardware, Hinges and Mounting Brackets, as well as on all full high aluminum mounting brackets, against defects in material and workmanship. All other hardware will be provided with a manufacturer's One (1) year written limited warranty, against all defects in material and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
    1. Columbia Partitions: www.psisc.com.
        a. Product - Phenolic Partitions Series 58000.
B. Other Approved Manufacturers:
    1. Bradley Corporation: www.bradleycorp.com.
    2. Bobrick Washroom Equipment, Inc: www.bobrick.com.
    3. Metpar Corporation: www.metpar.com.
    4. Accurate Partitions Corp: www.accuratepartitions.com.
    5. General Partitions: www.generalpartitions.com.
    6. Global Steel Products Corp: www.globalpartitions.com.
    7. Substitutions: Section 01 6000 - Product Requirements.

2.02 INSTALLATION TYPE

A. Toilet Compartments: Overhead-braced, floor supported.
    1. Overhead brace to be installed 4 inches below ceiling height.
    2. Door to terminate below fixed panel with no major gap in between. Door and side panel to be held off of floor 6 inches.

2.03 MATERIALS

A. Material shall be Solid Phenolic with a High Pressure Melamine matte finish surface made as an integral part of the core material. Laminated surfaces are not acceptable.

1. Surface and edges shall be non-porous and shall not support fungus or bacteria. Provide material which has been selected for uniform color, surface flatness and smoothness.
2. Exposed surfaces which exhibit discolorations, pitting, seam marks, roller marks, stains, telegraphing of core material, or other imperfections on finished units are not acceptable. Defects such as chipping along edges and corners are unacceptable.
3. Solid Phenolic shall meet or exceed all requirements for Class B Flame Spread Rating and Smoke Developed calculated according to ASTM E84, and shall carry a Class B Fire Rating Certification. Class B Fire Rating Certification shall be in the name of the Toilet Partition Manufacturer and shall be less than six (6) months old.

B. Material Thicknesses:
1. Doors - Minimum .75 inch (19 mm) Finished Thickness.
2. Divider Panels - Minimum .50 inch (13 mm) Finished Thickness.
3. Pilasters - Minimum .75 inch (19 mm) Finished Thickness.

C. Door Height:
1. Doors: 9'-2" (4 inches from ceiling; 6 inches from floor).

D. Colors: To be selected by Architect from Melamine Manufacturer's full range of colors, including premium.

2.04 HARDWARE

A. Continuous Hinge: Continuous Hinge length to correspond with door height. Shall be made of Type 304, 14 gage (2 mm) Stainless Steel and shall have a Polished Satin Finish. Hinge shall be 3 inches (76 mm) wide and shall have cam knuckles for gravity type self-closing action. Pivot pin shall be 0.250 inch (6 mm) in diameter, and shall be made of Type 304 Stainless Steel.
1. Pivot pin shall be 0.250 inch (6 mm) in diameter, and shall be made of Type 304 Stainless Steel.
    a. Pivot pin shall be non-removable.
2. Hinges shall provide emergency access by lifting the door. Inswinging Hinges shall be preset to hold Door open at 15 degrees and Outswinging Hinges shall be preset to hold Doors in the closed position when unlatched. Hinges shall be pre-drilled for mounting to door and pilaster.
3. Mounting holes shall be at 9 inches (229 mm) O.C. for mounting to door and pilaster with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Brass inserts are unacceptable.
4. Each Hinge is to be labeled by stock number, manufacturer, and left or right hand. Furnish one Hinge per door.

B. Slide Latch: Slide Latch shall be Heavy Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. The Slide Latch shall be surface mounted and shall require less than five (5) lbs (2.3 kg) to operate.

C. Coat Hook: Coat Hook shall be made of Heavy Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. Coat Hook and Bumper shall be 2.340 inches (59 mm) high, 1.230 inches (31 mm) wide and shall protrude out from the door 3.05 inches (77 mm).
1. The hook portion shall have a finished diameter of 0.250 (6 mm). Coat Hooks shall be mounted to the Door with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Stamped Stainless Steel Coat Hooks are unacceptable.
2. The stock number shall be molded into the back of the Coat Hook and Bumper for ease in identification. Furnish one per door.

D. Pull Handle: Pull Handle shall be made of Heavy Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. Chrome Plated Zamac and Stamped Stainless Steel Door Pulls are unacceptable.

1. Pull Handle shall protrude from the face of the door 0.940 inch (24 mm) and shall be 4.735 inches (120 mm) long. The Pull Handle shall have mounting holes drilled and tapped for 10/24 threads at 3.50 (89 mm) O.C. The Pull Handle shall be0 .655 inch (17 mm) wide.
2. The stock number shall be molded into the back of the Pull Handle for ease in identification. Furnish two for each Disabled Accessible door.

E. Door Stop: Door Stop shall be Heavy Duty Type 304 Cast Stainless Steel with a Polished Satin Finish. Chrome Plated Zamac and Stamped Stainless Steel Door Stops are unacceptable.
1. Door Stop shall have a 2.125 inch (54 mm) base diameter and shall protrude 1.80 inches (46 mm) from the wall. The bumper at the end of the Door Stop shall be 0.250 (6 mm) thick. The diameter of the shaft shall be 0.6875 inch (17 mm).
2. The stock number shall be molded into the back of the Door Stop for ease in identification. Furnish one for each Disabled Accessible or outswing door.

F. Continuous Mounting Brackets: Brackets shall be Full High, 9'-2" Type 304 Stainless Steel and shall have a Polished Satin Finish. Continuous Double Ear and Single Ear Brackets shall be used to mount panel/pilaster to wall. Continuous ‘U’ Brackets shall be used to mount panel to pilaster.
1. Inside opening of Bracket shall be 0.50 inch (13 mm) for panels and 0.75 inch (19 mm) for pilasters. All holes in Brackets for mounting to wall and panel/pilaster shall be pre-drilled. Holes are to be spaced at 9 inches (229 mm) O.C. along the full length of the Bracket for a total of fourteen (14) holes for mounting to wall, and seven (7) for mounting to panel or pilaster.
2. Panels and Pilasters shall be secured to Brackets with Theft Proof Stainless Steel Torx Head with Pin Through-Bolts. Attachments made with screws into core material are unacceptable. Brackets made of Aluminum, Chrome Plated Zamak or Single High Stamped Stainless Steel are unacceptable.

G. Overhead Bracing (Headrail): Continuous Heavy Duty Extruded 6063-T5 Aluminum Headrail with Anti-Grip profile. Headrail shall have a Satin Anodized finish and shall have integral reinforcing channel and curtain track.
1. Provide Headrail Corner Brackets, Wall Brackets, and Headrail End Caps as required. The Headrail and Aluminum Headrail Corner Brackets shall have a minimum wall height of 2 inches (51 mm). The minimum wall thickness of the Headrail and Headrail Corner Brackets shall be 0.125 inch (3 mm).
2. The Headrail Wall Brackets shall be made of Type 304, 18 gage (1.3 mm) Stainless Steel.

H. Boot: 4-inch Type 304 Cast Stainless Steel with a Polished Satin Finish.

I. Anchorages and Fasteners: All Fasteners shall be Type 304 Stainless Steel and shall have Theft Proof Torx Heads with Pin. Stainless Steel Through-Bolts shall withstand a direct pull force in excess of 2000 lbs (907 kg) each. All Fasteners shall be Through-Bolted unless noted otherwise. Chrome Plated Steel, Zinc Plated Steel and Brass Fasteners are not acceptable.
1. All Fasteners shall be Through-Bolted unless noted otherwise. Chrome Plated Steel, Zinc Plated Steel and Brass Fasteners are not acceptable.

2.05 FABRICATION

A. General: Provide Doors, Panels, and Pilasters fabricated for the partition system, complete with all accessories and hardware listed above and as required for installation of a fully functional system, unless otherwise noted. Provide units with cutouts and drilled holes to receive partition-mounted hinges, accessories, and grab bars as indicated.

B. Pilasters: Each Pilaster shall have zinc plated threaded insert(s) threaded into the base of the Pilaster to receive 0.3125 x 2.5 inches (8 x 64 mm) ASTM A666 Type 304 Stainless Steel Jack Bolt(s) for leveling purposes. Pilaster Shoe shall be 3 inches (76 mm) high Type 304, 18 gage (1.3 mm) Stainless Steel and shall have an integral heel for structural connection to the floor with Stainless Steel fasteners.
C. Doors: Unless otherwise indicated, provide 24 inche (610 mm) wide in-swinging doors for standard Toilet Partitions and 36 inch (914 mm) wide out-swinging doors with a minimum 32 inch (813 mm) wide clear opening for Partitions indicated to be Handicapped Accessible. Doors to terminate below overhead brace, which is to be placed 4 inches below ceiling. Doors to be placed 6 inches above floor. Overall door height to be 9'-2".
D. Privacy Option Sightless Strike: The vertical edges of all Doors and Pilasters shall be rabbetted to a width and depth of 0.375 inch to provide for a sightless condition between the Door and Pilaster. Note: The Door width will be greater than the opening size. The rabbetted edge of the Door will overlay the rabbetted portion of the Pilaster to provide a sightless condition. The rabbetted portion of the Pilaster shall act as the Strike.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that room dimensions are in accordance with Toilet Partition Shop Drawings. Inspect walls to insure that they are plumb and suitable for the Wall Brackets.
B. Check location of entrance doors and location of plumbing fixtures. Verify that these are in accordance with Toilet Partition Shop Drawings and that there is adequate clearance between plumbing fixtures and dividing panels or screens.
C. Have any inappropriate conditions corrected before beginning installation.

3.02 INSTALLATION

A. All partitions and screens to be installed with 16" clearance from the floor to the bottom of the partition or screen.
B. Comply with manufacturer’s written installation instructions.
    1. Install Partitions rigid, straight, plumb, and level. Provide clearances of not more than 0.50 inch (13 mm) between pilasters and panels, and not more than 1.0 inch (25 mm) between pilasters/panels and walls.
    2. No evidence of drilling, cutting and patching shall be visible in finished work.
C. Overhead-Braced Floor Supported Partitions: Secure Pilasters to floor and level, plumb, and tighten.
    1. Maintain proper Door Openings and secure continuous Overhead Brace (Headrail) to each pilaster with not less than two (2)Theft Proof Stainless Steel Torx Head with Pin Through-Bolts.
    2. Hang Doors and adjust so that tops of Doors are parallel with Overhead Brace and are the same height as the panels when doors are in closed position.
D. Screens: Attach with anchoring devices according to manufacturer’s written instructions and to suit supporting structure.
    1. Set units level and plumb.
E. Mount accessories to Partition units in accordance with accessory manufacturer’s instructions.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING AND CLEANING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Hardware Adjustment: Adjust hardware according to manufacturer's written instructions for proper operation. Adjust cam on all out-swinging doors to hold doors in closed position when unlatched. Adjust cam on all in-swinging doors to hold doors in open position when unlatched.
C. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
D. Adjust adjacent components for consistency of line or plane.
E. Provide final protection and maintain conditions that ensure Toilet Partitions and Screens are without damage or deterioration at the time of Substantial Completion.
F. Clean all exposed surfaces of Toilet Partitions and hardware.

END OF SECTION 10 2114

SECTION 10 2601

WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Wall and Corner Guard work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Corner guards.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
    1. Submit two sections of corner guards, 24 inches long.
E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
B. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
    1. Basis of Design
        a. Inpro: www.inprocorp.com.
    2. Other Approved Manufacturers
    3. Babcock-Davis: www.babcockdavis.com.
    4. Construction Specialties, Inc: www.c-sgroup.com.
    5. Koroseal Interior Products: www.koroseal.com.
    6. Nystrom, Inc: www.nystrom.com.
    7. Trim-Tex, Inc: www.trim-tex.com.

8. Pawling Corporation: www.pawling.com.
9. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PRODUCT TYPES

A. Stainless Steel Corner Guards - Surface Mounted: One piece, installed with adhesive and screws.
   1. Material: Type 304 stainless steel, No. 4 finish, 16 gage, 0.06 inch thick.
   2. Width of Wings: 2 inches.
   3. Corner: Square.
   4. Color: As selected from manufacturer's standard colors.
   5. Length: One piece, 48 inches unless noted.
   6. Styles: Provide both 90 degree corners and 180 degree wall end protectors.
   7. Products:
      a. Inpro Stainless Surface Mount Stainless Steel Corner Guard.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
B. Verify that field measurements are as indicated on drawings.
C. Verify that substrate surfaces for adhered items are clean and smooth.
D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
B. Position corner guard 4 inches above finished base.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.
B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION 10 2601

SECTION 10 2800

TOILET, BATH, AND UTILITY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Toilet, Bath and Utility Accessory work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Commercial toilet accessories.
C. Accessories for toilet rooms, showers, and utility rooms.
D. Soap dispenser.
E. Electric hand/hair dryers.
F. Mirrors.
G. Utility room accessories.
H. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 09 3000 - Tiling.
B. Section 10 2114 - Phenolic Toilet Compartments.
C. Section 22 4000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 OWNER FURNISHED ITEMS (N.I.C.)

A. The following shall be supplied by the Owner for installation by the Contractor.
    1. Refer to Section 01 1000 for owner supplied items.
        a. Waste receptacle.

1.04 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a (Reapproved 2019).
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017.
F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

1.07 GUARANTEE

A. Provide Manufacturer Product Warranties on installed products.
B. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Bradley Corporation: www.bradleycorp.com.
B. Other Manufacturers
   1. AJW Architectural Products: www.ajw.com.
   2. American Specialties, Inc: www.americanspecialties.com.
   3. Bobrick Washroom Equipment Inc: www.bobrick.com.
   4. American Accessories Inc: www.aaiusaonline.com.
   5. Columbia Accessories: www.psisc.com.
   6. Seachrome: www.seachrome.com
   7. Substitutions: Section 01 6000 - Product Requirements.
C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
C. Stainless Steel Sheet: ASTM A666, Type 304.
D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
F. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
G. Adhesive: Two component epoxy type, waterproof.
H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.
B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.
C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
D. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.
E. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

F. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
G. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 TOILET ROOM ACCESSORIES

A. Electric Hand Dryer:
   1. Bobrick; Quietdry Series Trimdry B-7128.
   2. Cover: Stainless Steel
   3. Motor:
      a. Electrical Supply: 115V.
B. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
   1. Minimum Capacity: 48 ounces.
C. Mirrors: Stainless steel framed, 1/4 inch thick tempered safety glass; ASTM C1048.
   1. Size: As indicated on drawings.
   2. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
   4. Products:
      a. 781 Series manufactured by Bradley Corporation.
      b. Substitutions: Section 01 6000 - Product Requirements.
D. ADA Toilet Grab Bars: Stainless steel, textured surface, 1-1/2 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
   1. Length and configuration: As indicated on drawings.
   2. Product: 812 Series manufactured by Bradley Corporation
   3. Substitutions: Section 01 6000 - Product Requirements.
E. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, full-length stainless steel piano-type hinge, removable receptacle with tumbler lock.
   1. Products:
      a. 4722-15 manufactured by Bradley Corporation.
      b. 4781-11 manufactured by Bradley Corporation.
      c. Substitutions: Section 01 6000 - Product Requirements.

2.05 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Hooks: 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
   2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   3. Length: Manufacturer's standard length for number of holders/hooks indicated on Drawings.
   4. Products:
      a. Product: 9933/9934 manufactured by Bradley Corporation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. Verify that field measurements are as indicated on shop drawings.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.
B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
B. Install plumb and level, securely and rigidly anchored to substrate.
C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 2800

SECTION 10 5100

METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Metal Locker work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Heavy-duty all-welded lockers for:
   1. Reading Facilitator Room.
   2. Kitchen.
   3. ADA-Compliant lockers of all types specified, per latest regulations.
C. Metal tops, sloped.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete base construction.
B. Section 06 1000 - Rough Carpentry: Wood blocking and nailers.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ADAAG - ADA Accessibility Guidelines (ADAAG); 2002.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
D. Samples: Submit two samples 12 by 12 inches in size showing color and finish of metal locker material.
E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

1.06 GUARANTEE

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Faulty operation of latches and other door hardware.
   2. Damage from deliberate destruction and vandalism is excluded.
   3. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.
B. Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Penco Products, Inc: www.pencoproducts.com.
   2. Lyon Work Space Products, LLC.: www.lyonworkspace.com.
   3. Other manufacturers as approved by Architect prior to bidding.
B. Requests for substitutions will be considered in accordance with provisions of Section 01 6000.
C. Provide all metal lockers from a single manufacturer.

2.02 MATERIALS

A. Steel: Sheet steel components to be fabricated using zinc-coated steel free from surface imperfection, capable of taking a high-grade enamel finish, and compliant with ASTM A879/A879M.
B. Hooks: Zinc-plated forged steel, ball ends.
C. Bolts and Nuts: Zinc-plated truss fin head bolts and hex nuts.

2.03 HEAVY DUTY ATHLETIC LOCKERS

A. Heavy Duty All-Welded Lockers: All locker body components made of cold-rolled steel specially formed for added strength and rigidity and to ensure tight joints at fastening points. All-
   1. Kitchen:
      a. Single Tier: 15 inches wide by 15 inches deep by 72 inches high
      b. Provide hooks on each side of locker interior.
   2. Reading Facilitator:
      a. Two-tier, single point latch locker. 15 inches wide by 15 inches deep by 72 inches high; welded channel base by locker manufacturer.
B. Locker Body Components (All-Welded Lockers):
   1. Sides, Bottoms, Tops, and Shelves:
      a. 16 gauge steel.
   2. Backs: Solid 18 gauge steel.
      a. Groups to 48 inches (1.219 m) wide: One piece back.
      b. Groups over 48 inches (1.219 m) wide: Two piece back.
   3. Doors:
      a. 14 gauge steel.
   4. Sides: Vertical frames and sides.
      a. Intermediate Vertical Side Frames: Another frame channel securely welded to side frame.
      b. No Ventilation; solid sides.
   5. Tops: Notched and formed sheet; one continuous flat top for each group of lockers.
   6. Bottoms: Notched and formed sheet; one continuous bottom for each group of lockers suitable for anchoring to wood or concrete bases.
   7. Shelves: Flanged on four sides with additional return flange on front edge to increase strength.
   8. Door Frames: 16 gauge formed in a channel shape with continuous vertical door strikes.
C. Locker Doors: One piece sheet steel.
   1. Ventilation:
      a. Provide louvered doors in manufacturer's standard inverted (inside) mini-louver pattern, louvers 5/8 inch (15.8 mm) wide and 1/4 inch (6.3 mm) high.
D. Hinges: Continuous piano hinge for the full height of the door.
E. Accessories:

1. Number Plates: Provide each locker with a polished aluminum number plate, 2-1/4 inches (57 mm) wide by 1 inch (25 mm) high, with black numerals not less than 3/8 inch (9.5 mm) high; attach to face of door with two aluminum rivets.
2. Continuous Sloped Hoods (at Kitchen lockers only): 16 gauge steel, slope rise equal to 1/3 of the locker depth (18.5 degrees), plus a 1 inch (25 mm) vertical rise at front.
    a. Supplied in 72 inch (1829 mm) lengths only.
    b. Slip joints without visible fasteners at splice locations.
    c. Provide necessary end closures.
    d. Finish to match lockers.
3. Finished End Panels: Minimum 16 gauge steel formed to match locker depth and height, 1 inch (25 mm) edge dimension; finish to match lockers; install with concealed fasteners.
4. Front Fillers: 20 gauge steel formed in an angle shape, with 20 gauge slip joint angles formed in an angle shape with double bend on one leg forming a pocket to provide adjustable mating with angle filler.
    a. Attachment by means of concealed fasteners.
    b. Finish to match lockers.

2.04 FABRICATION

A. Locker Finish: Powder Coat Paint.
    1. Powder Coat - Dry Thickness: 1 to 1.2 mils (.025 to 0.03 mm).
    2. Color: As selected by Architect from manufacturer's standard colors.
B. Fabricate lockers square, rigid, without warp, with metal faces flat and free of distortion.
C. Finish: Enamel powder coat paint finish electrostatically applied and properly cured to manufacturer’s specifications for optimum performance. Finishes containing volatile organic compounds and subject to out-gassing are not acceptable. Locker exterior and interior shall be painted the same color.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Place and secure on prepared base.
C. Install lockers plumb and square.
D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
E. Bolt adjoining locker units together to provide rigid installation.
F. Install end panels, filler panels, and sloped tops.
G. Install fittings if not factory installed.
H. Replace components that do not operate smoothly.

3.03 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 5100

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SECTION 10 5617

WALL MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel shelf standards, brackets, and accessories.
B. Shelves.
C. Steel shelving.
D. At custodial and mechanical rooms.
E. Wood shelving at band storage.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking in walls for attachment of standards.
B. Section 06 2000 - Finish Carpentry: Wood shelves.
C. Section 09 2116 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products under cover and elevated above grade.
B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 COMPONENTS

A. Steel Shelf Standards, Brackets, and Accessories:
    1. Heavy-Duty Shelf Standards and Brackets: Double-slotted channel standards for brackets adjustable in 1 inch increments along entire length of standard, drilled and countersunk for screws.
        a. Acceptable Product: KV 82/182.
        b. Load Capacity: Recommended by manufacturer for loading of 300 to 450 pounds per pair of standards.
        c. Lengths: As indicated on drawings.
        d. Color: To be selected by Architect from manufacturer's full line.
        e. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.

f. Bracket Quantity: Provide one bracket for each 12 inches of standard length.

2. Shelf Standard Accessories:
   a. At shelves indicated as sloping provide adjustable slant brackets.
   b. Where cornices are indicated as part of shelving provide cornice brackets.
   c. Where shelves are indicated to be fastened to brackets provide brackets with flanges for screwing into end of shelf, steel shelf rests, or flanged brackets; fasten with screws.
   d. Provide other accessories as indicated.

B. Wood Shelves: Hardwood veneer plywood with matching solid wood glued edges on all four edges.
   1. Thickness: 3/4 inch, nominal.
   2. Length: 5 feet.
   3. Finish: Polyurethane varnish.
   4. Application: Use wood shelves in music room.
   5. Shelf Quantity: Provide six (6) 6-foot-tall shelves with one (1) shelf per foot.
   6. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Mount standards to solid backing capable of supporting intended loads.
C. Install brackets, shelving, and accessories.

3.04 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 5617

SECTION 10 7500

FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Flagpole work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Aluminum flagpoles and flags.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.03 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
E. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on pole, accessories, and configurations.
C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
D. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
B. Protect flagpole and accessories from damage or moisture.

1.07 GUARANTEE

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer:
   1. Concord Industries, Inc; Product - "Monarch": www.concordindustries.com.
B. Other Approved Manufacturers:
   1. American Flagpole: www.americanflagpole.com.
   2. Colonial Flags: www.colonialflags.com
   3. Pole-Tech Co., Inc: www.poletech.com.
   4. Admiral Flag Poles : www.admiralflagpoles.com.
   5. Eder Flagpole Co.: www.ederflag.com.
   6. Morgan-Francis Flagpoles: www.morgan-francis.com.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001
   1. Material: Aluminum.
   2. Design: Cone tapered.
   3. Mounting: Ground mounted type.
   4. Nominal Wall Thickness: 0.188 inches.
   5. Nominal Height: 35 ft; measured from nominal ground elevation.
   6. Halyard: Interior type, [manual type].
B. Performance Requirements:
   1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 90 miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B221 (ASTM B 221M), 6063 alloy, T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Aluminum, 6 inch diameter, gold anodized with deep luster finish.
B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling, cast nylon sheaves, double halyard.
C. Flag: USA Flag - 5 ft by 8 ft size, nylon fabric, brass grommets, hemmed edges.
D. Internal Halyard, Cam Cleat System: 5/16-inch (8 mm) diameter, braided polypropylene haylard, white; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
   1. Halyard Flag Snaps: Provide four chromium-plated bronze swivel snap hooks per halyard.
      a. Provide with neoprene or vinyl covers.
E. Lighting
   1. Dome Down Lighting that incorporates the latest LED technology.

2.05 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch steel, galvanized, depth as indicated on drawings.
   1. A steel base plate with the square dimension at least twice the butt diameter of the shaft shall be provided.

2. The thickness of the base plate shall bee 1/2 inch (13 mm).
3. A setting plate of the same thickness at the base plate shall be provided in a size that is half the size of the base plate.
4. The setting plate shall be securely welded to the ground spike at least 4 inches (102 mm) below the base plate.
5. The ground spike shall be 3/4 inch (19 mm) diameter, not less that 18 inches (457 mm) long.

B. Collar:
1. The flash collar, or ornamental base, shall be cast aluminum, Type FC-11.
2. The diameter of the collar shall be at least 1 inch larger than the diameter of the foundation sleeve.
3. The finish shall be "deep luster."

C. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.06 FINISHING

A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
C. Exposed to View Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
D. Aluminum: Deep luster finish with heavy wax coating.
E. Stainless Steel: No. 4 satin finish.
F. Finial: Gold anodized finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.02 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 INSTALLATION

A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
B. Electrically ground flagpole installation.
C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.05 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION 10 7500

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SECTION 11 4000

FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.01 CONDITIONS:

All the applicable requirements of Division 0 and Division 1 apply to the work of this section.

1.02 This specification and the accompanying drawings must be considered together; any work called for in one or on the other, together with such work as can reasonably be considered a part of the installation and necessary to complete same shall be included.

1.03 SCOPE:

A. Work included: It is the intention of these specifications to designate an inclusive job, complete, ready to use, except plumbing, heating and electrical connections which shall be made by other contractors. All equipment shall be set in place, leveled, and after utility connections have been made, ready for use.

B. Uniformity of Construction: All specially built equipment shall be made by one manufacturer, and shall be uniform throughout as to method and type of construction used. All equipment shall carry a nameplate identifying the manufacturer.

C. Bid Performance: All bidders must show evidence of their ability to perform the contract and must be regular furnishers and fabricators of such equipment.

D. Specifications, Substitutions: The successful contractor will be bound to furnish equipment in strict accordance with the specifications, including specific manufacturer, model number, size, utilities requirements, capacities, etc., as well as options and accessories. Supplemental to the base bid for the prime equipment as specified, the Food Service Contractor may propose substitution (alternate) equipment other that specified. The Contractor must clearly and separately state that they are offering an alternate. The Contractor shall submit complete illustrations, capacities, and utilities, as well as all operational data for all proposed alternates as well as applicable price differences. It is the Contractor's responsibility to prove that the item or items submitted as alternatives are equal to the prime specified items. The Owner with counsel from the Food Service Consultant will be the final determining authority as to acceptability or equality of alternates. Items of standard equipment must be the latest model and new at time of delivery. Approval prior to the bid date to submit alternates is not required. At a time requested in writing by the Owner and/or the Foodservice Consultant, the Contractor will be responsible for determining all relative costs associated with the use of alternate equipment. Should substitution be accepted and should the substitute material, specialty or manufactured article prove to be defective or otherwise unsatisfactory for the service intended and with the guarantee period, the Contractor shall replace this material, specialty or manufactured article with that specified.

E. Equipment Protection: All equipment shall be received at the building fully protected. It will be the responsibility of the Kitchen Contractor to protect the equipment until completely installed.

F. Building Codes, Regulations, National Sanitation Foundation Standards: All kitchen equipment shall be manufactured and installed in compliance with all city, state and Federal regulations and code requirements, and in accordance with the latest revised standard of the National Sanitation Foundation Testing Laboratory, Ann Arbor, Michigan, and shall bear their seal of approval.

G. Field Dimensions: The Contractor shall be required to take all field measurements and be responsible therefor. It shall also be the duty of this contractor to coordinate the location of chases and passageways for supply lines in the building. It is recommended that where time does not permit the use of finished field dimensions in fabrication of this equipment, that measurements be determined by General Contractor & Architect and then given to the Kitchen Contractor in writing.

H. Refrigeration Units: All refrigeration units, hereinafter specified, are to be completely installed by the Food Service Equipment Contractor except for final electric, water (if water connections are specified) and drain units, the Food Service Equipment Contractor shall furnish necessary charge of refrigerant, start and adjust equipment and service same for a period of one year final acceptance by the

Owner.

1.04 RELATED WORK IN OTHER SECTIONS:

A. Plumbing: Plumbing connections to equipment will be provided under another section of the specifications including shutoff valves, piping and sink traps necessary to connect up after equipment is installed in place. The Food Service Equipment Contractor shall furnish all necessary faucets and sink drains.

The steam and gas connection of equipment shall be provided in another section of the specifications, which will include all final connections to the equipment with the shutoff valves and the supply and return.

B. Electrical: The electrical contractor will furnish disconnect switches and do all wiring to motor starters, motors, automatic controls, protective devices, etc. The Food Service Equipment Contractor shall supply, for each motor driven appliance, for electrically heated units, a suitable control switch or starter of proper type in accordance with Underwriters Code. Loose controls or switches furnished with brand name equipment are to be completely installed by Electrical Contractor.

All electrical equipment shall be correct for the type of electrical current available.

1.05 SUPERVISION AND INSTRUCTION:

A. Supervision: The Food Service Equipment Contractor shall visit the job site to check mechanical rough-ins prior to the pouring of the floor slabs and advise the General Contractor of any discrepancy. Cost to relocate or add utility lines due to the failure of the Food Service Equipment Contractor to verify their proper location prior to the pouring of the floor slabs will be assumed by said Food Service Contractor.

Food Service Equipment Contractor shall remove all debris accumulated during the delivery and installation of his equipment immediately upon completion of said installation. He will provide a representative, when necessary, to correlate final hook-up related contractors, so as not to impede job progress. After final hook-up, he shall lubricate, start up and check all equipment turn over to the Owner, for acceptance, in first class condition, all items in his contract.

The Food Service Equipment Contractor shall provide a capable representative or representatives to demonstrate the proper use of the equipment, at the times selected by the Owner. The Owner is to give said Food Service Equipment Contractor a minimum of seven calendar days prior to this demonstration date.

B. Final Adjustment and Instructions to Owner:

1. When directed by the Architect at completion of this work, proved a competent service representative to be present when installation is put into operation.

2. Lubricate, clean with soap and water and put into proper operation all equipment and instruct the Owner's employees in the proper use and maintenance of all items in this contract, and set up a maintenance schedule to be followed thereafter.

3. Prepare a letter documenting the fact that instructional work has been accomplished, obtain signature of the Owner thereon, and submit to the Architect before final acceptance of the installation will be considered.

4. Furnish four bound sets of specification sheets of all standard manufactured items complete with service manuals and parts lists, to the Architect, along with shop drawings showing the plan and all mechanical and electrical hookups as installed.

1.06 GUARANTEE:

The Food Service Equipment Contractor shall fully guarantee all work and material for a period of

one year from the date the equipment is put into operation and accepted by the Owner.

Guarantee and condition of service on items of brand name manufacture, as established by the manufacturer, shall apply where extending beyond the guarantee and services set forth in these specification.

PART 2 - PRODUCTS

2.01 STAINLESS STEEL: All Stainless steel shall be of the gauge specified (U.S. Standard) 18-8 composition which is generally known as Type 302 or Type 304 and shall have a Number 4 finish, as manufactured within the continental limits of the United States. All sheets will have a genuine mill finish of not less than 180 grit on one side with not less than 100 grit on the back side. All stainless steel sheets which bear the manufacturer's trademark designation of type and heat number. All stainless shall have the following content:

Chromium -18 per cent minimum
Nickel -8 per cent minimum
Carbon -2 tenths per cent maximum

Straight chrome iron or copper bearing straight chrome iron will not be acceptable. All stainless steel sheets shall be stretcher leveled. All sheets shall be free of buckles, warps and surface imperfections. Bidders are particularly cautioned that a hard ground finished will not be acceptable.

2.02 GALVANIZED IRON: Wherever specified, iron shall be of an approved grade of wither low carbon steel or copper bearing steel to one of the following brands:

All sheets are to be commercial quality, stretcher level, bonderized and rerolled to insure a smooth surface.

Where galvanized iron is specified, it shall be copper bearing sheets used in the largest sizes with as few joints as possible. All welded joints are to be sandblasted and refinished with rustproof galvanized zinc compound. All galvanized iron it to be finished with a prime coat plus two finished coats of gray hammerloid enamel.

PART 3 - EXECUTION

3.01 WELDING: All welding shall be done in a thorough manner with all welds of the same composition as sheets or parts welded. Welds shall have full penetration the entire length of the joint and shall be flat without buckles, voids or imperfections. Welds shall be strong, ductile, with excess metal ground off and joints finished smooth to match the adjoining surface. Welds shall be of the same color as the adjacent metal, ground and polished on the exposed side and ground on the back side. Welds to be free of imperfections such as pits, runs, splatter, cracks, etc. All joints in the tops of fixtures, drainboards, shelving, sinks, etc. shall not be welded with the carbon arc welding or by any method permitting carbon pickup. Soldering riveting, bolting or spot welding of seams in tops is not acceptable for full arc welding. It is the intention of this specification that all welded joints shall be homogenous with the sheet metal itself.

3.02 GRINDING, POLISHING AND FINISHING: All exposed welded joints, including field joints, shall be suitable ground flush with the adjoining material and neatly finished to harmonize with same. Wherever material has been depressed or sunken in by the welded operation, such depressions shall be suitably hammered and peened flushed with the adjoining surfaces and, if necessary, again ground to eliminate low spots. All ground surfaces shall then be polished or buffed to match adjoining surfaces, consistent with good workmanship. Care shall be exercised in all grinding operations to avoid excessive heating of the metal and metal discoloration. In all cases the grain of rough grinding shall be removed by successive finer polishing operations. The texture of the final polishing operation shall be uniform and smooth, consistent with reasonable care and good workmanship. The general finish of all metal shall be of a high grade. Wherever break bends occur they shall be free of open texture or orange peel appearance: and where such break work does not mar the uniformity of the appearance of the material, all such marks shall be removed by suitable grinding, polishing and finishing. Wherever sheared edges occur, they shall be free of burrs, projections and fins to obviate all danger of cutting and laceration when

the hand is drawn over such sheared edges. Where miters of bullnose corners occur, they shall be neatly finished with the under edges of the material neatly ground to a uniform condition and in no case shall overlapping material be acceptable.

ITEM 1 - TWO (2) COMPARTMENT SINK (1 REQ'D)
Advance Tabco Model 94-42-48-36RL
Regaline Sink, 2-compartment, with left & right-hand drainboards, 24" front-to-back x 24"W sink compartment, 14" deep, with 11"H backsplash, stainless steel legs with adjustable left-to-right and front cross rails, 36" drainboards, stainless steel bullet feet, 14 gauge 304 stainless steel, overall 32" F/B x 125" L/R, NSF

2 ea Model K-15 Lever Waste Drain, twist handle operated with built in overflow, fits 3-1/2" drain opening, 2" NPT & 1-1/2" IPS outlet connections
2 ea Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain
2 ea Model K-476 Punch hole for overflow drain, (1) punch required for each overflow drain, (please specify make & model of overflow used) (required for overflows unless using K-15)

ITEM 1.1 - WALL / SPLASH MOUNT FAUCET (1 REQ'D)
T&S Brass Model B-0231
Sink Mixing Faucet, wall mount, 8" centers, 12" swing nozzle, lever handles, quarter-turn Eterna cartridges, 1/2" NPT female inlets, low lead, ADA Compliant

ITEM 2 - HAND SINK (4 REQ'D)
Advance Tabco Model 7-PS-50
Hand Sink, wall mounted, 14" wide x 10" front-to-back x 5" deep bowl, 20 gauge 304 stainless steel, with heavy duty splash mounted gooseneck faucet, lever drain with overflow, P-trap, wall bracket, NSF, cCSAus

ITEM 3 - POT RACK (1 REQ'D)
Advance Tabco Model SC-108
Pot Rack, ceiling hung, triple bar design, 108"W x 22"D, constructed of 1/4" x 2" stainless steel, includes: (18) plated double pot hooks & 24" plated hanging chains

ITEM 4 - WORK TABLE, STAINLESS STEEL TOP (2 REQ'D)
Advance Tabco Model VKS-307
Work Table, 84"W x 30"D, 14 gauge 304 stainless steel top with countertop non drip edge, 10" backsplash, adjustable stainless steel undershelf, stainless steel legs & adjustable bullet feet, NSF

2 ea Model SHD-1520 Drawer, 15"W x 20"D x 5" deep drawer pan insert, heavy duty, self-closing, stainless steel, NSF

ITEM 5 - WALK-IN COOLER (1 REQ'D)
Kolpak Model -
Cooler with to be sized as per plan x 8'-6" high.
Panels shall consist of foamed-in-place "tongue and groove" with "Posi-Loc" locking assemblies foamed-in-place at time of fabrication.

Each panel shall be filled with ridge "foamed-in-place" urethane having a thermal conductivity (K-factor_ of 0.121 BTU/HR/SQ.FT. per degrees Fahrenheit/inch and an overall coefficient of heat transfer (U factor) of not more than 0.030, "R" factor shall be 33.3. Insulation shall have a 97% closed cell structure, average in-place density of 2.2 lbs. per cubic foot, and a compression strength at yield point of 19 lbs. per square inch. Overall thickness shall be 4". Fire hazard classification according to ASTME-84 (UL 723) has a

flame spread of 25" or less and certified with UL label, box shall have a FM-25 rating.

Provide (2) 48"L.E.D. lights as shown on drawing.
Exterior ceiling shall be galvalume. Interior and exterior wall shall be galvalume steel. Interior ceiling and walls to be white. Front exposed wall and door to be stainless steel #4 finish. Door jamb and door perimeter shall be made of Fiberglass Reinforced Plastic (F.R.P.).
A digital thermometer shall be included with each door section to indicate inside temperature. All walk-ins shall be fabricated to comply with National Sanitation Foundation Standard #7. The NSF label shall be affixed to the interior door pan. Interior corners and floor shall be coved to meet NSF specifications.
Provide enclosure panels from top of walk-in to ceiling of same material as exterior of walk-in. Also, provide enclosure panels between walk-in sides and walls, same material. No common walls with freezer.

Installation Notes: Assemble and set-in-place as per plans.

ITEM 5.1 - WALK-IN COOLER EVAPORATER (1 REQ'D)
Kolpak Model -
WALK-IN COOLER EVAPORATOR

A. (To be connected to emergency power)

B. 5/8" indirect line to floor sink

C. Size to maintain 35 degree F. in box as per plan

D. Electrical Contractor to interconnect refrigeration system as required.

E. Plumber Contractor to provide and install drain lines and heat trace from blower coils in box.

ITEM 5.2 - WALK-IN COOLER CONDENSER (1 REQ'D)
Kolpak Model -
WALK-IN COOLER CONDENSER
A. (To be connected to emergency generator)
B. Interconnect refrigeration lines with Item
C. Include Prepiped hermetice compressors with dryers, sigh glasses and head pressure controls. per-wired electrical panel, defost cloc, prssure controls and crankcase heaters. (Verify all requirements with manufacturer)
D. Verify location of unit.
E. Provide with mounting skids.
F. Size to maintain 35 degree F in box as per plan
G. Electrical Contractor to inconnect refrigeraton system as required.
H. Plumbing Contractor to provide and install drain lines from blower coils in box
I. General Contractor to provide wall penetratons from ceiling to blower coils at walk-in

ITEM 6 - WALK-IN FREEZER (1 REQ'D)
Kolpak Model -
Freezer with floor to be sized as per plan x 8'-6" high.
Panels shall consist of foamed-in-place "tongue and groove" with "Posi-Loc" locking assemblies foamed-in-place at time of fabrication.
Provide with floor and reinforced plywood.
Each panel shall be filled with ridge "foamed-in-place" urethane having a thermal conductivity (K-factor_

of 0.121 BTU/HR/SQ.FT. per degrees Fahrenheit/inch and an overall coefficient of heat transfer (U factor) of not more than 0.030, "R" factor shall be 33.3. Insulation shall have a 97% closed cell structure, average in-place density of 2.2 lbs. per cubic foot, and a compression strength at yield point of 19 lbs. per square inch. Overall thickness shall be 4". Fire hazard classification according to ASTME-84 (UL 723) has a flame spread of 25" or less and certified with UL label, box shall have a FM-25 rating.

Provide (2) 48"L.E.D. lights as shown on drawing.
Exterior ceiling shall be galvalume. Interior and exterior wall shall be galvalume steel. Interior ceiling and walls to be white. Front exposed wall and door to be stainless steel #4 finish. Door jamb and door perimeter shall be made of Fiberglass Reinforced Plastic (F.R.P.).
A digital thermometer shall be included with each door section to indicate inside temperature. All walk-ins shall be fabricated to comply with National Sanitation Foundation Standard #7. The NSF label shall be affixed to the interior door pan. Interior corners and floor shall be coved to meet NSF specifications. Provide enclosure panels from top of walk-in to ceiling of same material as exterior of walk-in. Also, provide enclosure panels between walk-in sides and walls of same material.

Installation Notes: Assemble and set-in-place as per plans.

Verify size and location prior to fabrication.
General Contractor to provide insulated floor for walk-in box.

ITEM 6.1 - WALK-IN FREEZER EVAPORATER (1 REQ'D)
Kolpak Model -
WALK-IN FREEZER EVAPORATOR

A. (To be connected to emergency power)

B. 5/8" indirect line to floor sink

C. Size to maintain 10 degree F. in box as per plan

D. Electrical Contractor to interconnect refrigeration system as required.

E. Plumber Contractor to provide and install drain lines and heat trace from blower coils in box.
Note: Drain lines MUST be wrapped with heat tape/strips.

ITEM 6.2 - WALK-IN FREEZER CONDENSER (1 REQ'D)
Kolpak Model -
WALK-IN FREEZER CONDENSER-
A. (To be connected to emergency generator)
B. Interconnect refrigeration lines with Item
C. Include Prepiped hermetice compressors with dryers, sigh glasses and head pressure controls. per-wired electrical panel, defost cloc, prssure controls and crankcase heaters. (Verify all requirements with manufacturer)
D. Verify location of unit.
E. Provide with mounting skids.
F. Size to maintain 35 degree F in box as per plan
G. Electrical Contractor to inconnect refrigeraton system as required.
H. Plumbing Contractor to provide and install drain lines from blower coils in box
I. General Contractor to provide wall penetratons from ceiling to blower coils at walk-in

ITEM 7 - HD RANGE, 18", 2 OPEN BURNERS (1 REQ'D)
Vulcan Model V2B18B
V Series Heavy Duty Range, gas, 18", (2) 35,000 BTU open burners, cast iron grates, storage base with cabinet doors, stainless steel front, front top ledge, sides, base, burner box & stub back, 6" adjustable legs, 70,000 BTU, CSA, NSF

1 ea	1 year limited parts & labor warranty, standard
1 ea	Natural gas (specify elevation if over 2,000 ft.)
1 ea	Model PRESREG-NA11/4 1-1/4" NPT pressure regulator (Natural gas)
1 ea	1-1/4" rear gas connection, standard
1 ea	Rear gas connection: cap & cover, both ends
1 ea	Model CASTERS-RR4 Casters, 5" (set of 4) (2 with locks)
1 ea	Model 11/4QDH 4FT 1-1/4" dia. x 4' flex hose & quick disconnect with restraining device
1 kt	Dormont Model 1675KIT48 Dormont Blue Hose™ Moveable Gas Connector Kit, 3/4" inside dia., 48" long, covered with stainless steel braid, coated with blue antimicrobial PVC, (1) SnapFast® QD, (1) full port valve, (2) 90° elbows, coiled restraining cable with hardware, 180,000 BTU/hr minimum flow capacity, limited lifetime warranty

ITEM 8 - CONVECTION OVEN, GAS (2 REQ'D)
Southbend (Middleby) Model PCG140S/SD
(QUICK SHIP) SilverStar Convection Oven, gas, double-deck, standard depth, solid state controls, stainless steel front, top & sides, aluminized steel rear, 60/40 dependent doors, interior light, 6" stainless steel legs, 144,000 BTU, (2) 1/2 HP, CSA, NSF (Ships within 2 days, maximum quantity = 2 per order)

2 ea	Quick Ship items have limited configurations & that standard configuration may not apply. Contact factory for details
2 ea	Domestic Shipping, inside of North America
2 ea	Standard (1) year limited parts and labor warranty (reference warranty document for details)
2 ea	Natural Gas
2 ea	Standard power system
2 ea	(2) 120v/60/1-ph, 7.9 amps, NEMA 5-15P, standard
2 ea	6" Casters in lieu of legs
2 ea	3/4" quick disconnect with 4 ft. hose, each
2 ea	3' Restraining device
1 kt	Dormont Model 1675KIT48 Dormont Blue Hose™ Moveable Gas Connector Kit, 3/4" inside dia., 48" long, covered with stainless steel braid, coated with blue antimicrobial PVC, (1) SnapFast® QD, (1) full port valve, (2) 90° elbows, coiled restraining cable with hardware, 180,000 BTU/hr minimum flow capacity, limited lifetime warranty

ITEM 9 - COMBI OVEN, GAS (2 REQ'D)
RATIONAL Model ICP 6-FULL ON 6-FULL NG 208/240V 1 PH
Two (2) (CC1GRRA.0000238) iCombi Pro® 6-Full Size Combi Ovens, double stack, natural gas, (12) 18" x 26" sheet pan or (24) 12" x 20" steam pan or (12) 2/1 GN pan capacity, (6) stainless steel grids included, intelligent cooking system with (4) assistants; iDensityControl, iCookingSuite, iProductionManager, & iCareSystem, (6) operating modes, (5) cooking methods, (3) manual operating modes, 85° to 572°F temperature range, quick clean, care control, eco mode, 6-point core temperature probe, retractable hand shower, Ethernet interface, Wi-Fi enabled, 106,500 BTU each, 208/240v/60/1-ph, 6 ft. cord, 0.9 kW each, CE, IPX5, cCSAus, NSF, ENERGY STAR-®

2 kt	Model 60.75.752 Combi-Duo Universal Stacking Kit, for iCombi 6-half size or 6-full size (electric or gas) on iCombi 6-full size (gas only)
2 ea	2 years parts and labor, 5 years steam generator warranty
2 ea	Model CAP Chef Assistance Program, a RATIONAL certified Chef conducts 4 hours/location specialized application training with personnel, no charge
2 ea	Model 1900.1158US Water Filtration Double Cartridge System, for full-size Combi-Duos or if used for more than (2) units, includes: (1) double head with pressure gauge, (2) R95-CL filter & (1) filter installation kit (for each additional unit add (1) additional head & additional cartridge. Maximum (4) cartridges)

ITEM 10 - PROOFER CABINET, MOBILE (1 REQ'D)
Cres Cor Model 121PHUA11D
Proofer/Hot Cabinet, non-insulated, removable bottom heater, wire universal slides for 12" x 20" thru 18" x 26" pans, on 4-1/2" centers, adjustable on 1-1/2", capacity (11) 18" x 26" sheet pans or (22) 12" x 20" pans, aluminum construction, field reversible Lexan door, integral drip trough, (4) 5" swivel casters (2) braked, CSA, cCSAus

1 ea	120v/60/1-ph, 2.0 kW, 16.7 amps, NEMA 5-20P, 6' 12/3 ga. power cord, standard
1 ea	Right-hand door swing, standard

ITEM 11 - KETTLE, GAS, TILTING (1 REQ'D)
Vulcan Model K40GLT
Tilting Kettle, Gas, 40-gallon true working capacity, 2/3 jacketed, 316 series stainless steel liner with ellipsoidal bottom, manual tilt, faucet bracket on tilting console, stainless steel construction, tri-leg base, 100,000 BTU

1 ea	1 year limited parts & labor warranty, standard
1 ea	Natural gas (specify elevation if over 2,000 ft.)
1 ea	110-120v/50/60/1-ph, 5.0amps, cord, standard
1 ea	Motorized Power Tilt
1 ea	NOTE: This unit includes: embossed gallon/liter markings, 316 stainless steel liner & heavy bar rim standard
1 ea	Model KTDOV PLUG2 K Series Plug Draw-off valve, 2" with perforated strainer
1 ea	Model SACOVER K40GLT Spring assist cover with condensate ring, field installed
1 ea	Model STRAINR K40 Tilting kettle pouring lip strainer, 40 gallon
1 ea	Model SUPPORT PANGLT Stainless steel receiving pan support (K tilt kettles, gas)
1 ea	Model 20X4 DRNPAN Drain pan & hose assembly
1 ea	Model DBLTS 18NZLJ DOUBLE Pantry Deck-Mount Faucet, 18" double jointed swivel spout, includes 4" & 12" riser, NSF & Lead Reduction Compliant (Note: water connection required)
1 ea	Model 3/4QD HOSE-4 3/4" x 4' long gas flex hose & quick disconnect with restraining device

ITEM 12 - FLOOR TROUGH (1 REQ'D)
Advance Tabco Model FTG-1836
Floor Trough, 36"W x 18"D x 4" deep, 14 gauge 304 stainless steel, includes stainless steel subway grating constructed from 3/16" x 1" bars, removable stainless steel strainer basket, 4" O.D. waste pipe 3"L, pitched towards waste, NSF

ITEM 13 - CONDENSATE HOOD (1 REQ'D)
Captive-Aire
Condensate hood for Dishwasher. Hood shall be of the exhaust only, full canopy type. Hood shall be constructed of 18 gauge, Type 304 stainless steel. Joints and seams shall be continuously welded liquid-tight, and all exposed external welds shall be ground and polished polished to match the original finish of the metal.
Hood shall include full-length, removable condensate baffles constructed of 18 gauge Type 304 stainless steel. Baffles shall be pitched to drain into a full perimeter, welded, condensate collecting gutter (with one-half inch N.P.T. stainless steel drain fitting). Provide stainless steel matching closure panels from top of hood to finished ceiling. Hood shall be fabricated in accordance with NFPA #96 and shall bear the NSF seal of approval.

Interconnect hood to dishwasher so when dishwasher turns on, hood turns on.

Utilities: (see mech. for fan.)

Installation Notes: Mount from ceiling as per plan. Gen. contractor to provide support from structure above as required to mount hood. Interconnect at exhaust duct , collars with exhaust system provided by mech. section

ITEM 14 - EXHAUST HOOD (1 REQ'D)
Captive-Aire Model ND-2-PSP-F
Furnish as shown on plans and in accordance with the following specifications. (District does NOT want Aquamatic)
The model ND-2 is an exhaust only canopy hood rated for all types of cooking equipment. The hood shall have the size, shape and performance specified on drawings and in accordance with the following specifications. Each exhaust hood shall be a high efficiency with stainless steel grease filters, make up air plenum, front discharge via perforated grilles, recognized or listed by UL, ETL and NSF, and built in accordance with the NFPA-96. The hood shall be a minimum 20 gauge, 304 stainless steel with NO. 4 finish on all surfaces. Construction shall be constructed with a double wall front to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96. The hood shall be furnished with U.L. classified high efficiency stainless steel filters. Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator. Corner hanging angles have a 5/8" x 1-1/2" slot pre-punched at the factory, allowing hanging rods to be used for quick and safe installation. Concealed grease trough with collection cup, to be easily accessible and removable. Recessed LED light fixtures shall be factory prewired to a single point on hood. Stainless steel matching closure panels from top of hood to finished ceiling, if required, by KEC.

Utilities: 115/60/1, 600 watts for lights
Installation Notes: Mount from ceiling as per plan 6'-8” above floor. Gen. contractor to provide support from
structure above as required to mount hood. Interconnect at exhaust duct, collars with exhaust system, provided by mech. section.

ITEM 15 - EXHAUST HOOD (1 REQ'D)
Captive-Aire Model ND-2-PSP-F
Furnish as shown on plans and in accordance with the following specifications. (District does NOT want Aqua-Matic)

The model ND-2 is an exhaust only canopy hood rated for all types of cooking equipment. The hood shall have the size, shape and performance specified on drawings and in accordance with the following specifications. Each exhaust hood shall be a high efficiency with stainless steel grease filters, make up air plenum, front discharge via perforated grilles, recognized or listed by UL, ETL and NSF, and built in accordance with the NFPA-96. The hood shall be a minimum 20 gauge, 304 stainless steel with NO. 4 finish on all surfaces. Construction shall be constructed with a double wall front to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96. The hood shall be furnished with U.L. classified high efficiency stainless steel filters. Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator. Corner hanging angles have a 5/8" x 1-1/2" slot pre-punched at the factory, allowing hanging rods to be used for quick and safe installation. Concealed grease trough with collection cup, to be easily accessible and removable. Recessed LED light fixtures shall be factory prewired to a

single point on hood. Stainless steel matching closure panels from top of hood to finished ceiling, if required, by KEC.

Utilities: 115/60/1, 600 watts for lights
Installation Notes: Mount from ceiling as per plan 6'-8" above floor. Gen. contractor to provide support from
structure above as required to mount hood. Interconnect at exhaust duct, collars with exhaust system, provided by mech. section.

ITEM 15.1 - FIRE SUPPRESSION SYSTEM (1 REQ'D)
Ansul Fire Protection Model R102
Model # R102 as manufactured by Ansul.
Utilities: Electrician to provide shunt trip switch to shut off electrical equip. under hood when system trips.
K.E.C. to provide mechanical gas valve installed by plumber to shut off gas equip. under hood when system trips.

ITEM 16 - UTILITY DISTRIBUTION SYSTEM - WALL (1 REQ'D)
Captive-Aire Model -
A Utility Distribution System shall provided be as indicated on drawings. Systems shall have two vertical risers, one on each end, with one dedicated to electrical and the other to plumbing. The horizontal distribution raceway between the risers shall be separated into electrical and plumbing compartments and each shall be completely enclosed and water tight with removable access panels. The risers and raceway shall be constructed of 16 gauge, type 304 stainless steel, #4 finish. A circuit protected dual convenience outlet shall be provided on each riser. Service connections shall be located behind easily removable access panels.

ITEM 17 - WORK TABLE, STAINLESS STEEL TOP (2 REQ'D)
Advance Tabco Model MS-307
Work Table, 84"W x 30"D, 16 gauge 304 stainless steel top, 18 gauge stainless steel adjustable undershelf, stainless steel legs & adjustable bullet feet, NSF

4 st	Model TA-25S-4 Casters, 5" diameter, set of 4 (2 with brakes) with stainless steel legs for standard working height of 35-1/2"
4 ea	Model SS-2020 Deluxe Drawer, 20"W x 20"D x 5" deep drawer pan insert, stainless steel, with drawer slides

ITEM 18 - ROLL-IN HEATED CABINET (2 REQ'D)
True Mfg. - General Foodservice Model STR1HRI-1S
SPEC SERIES® Heated Cabinet, roll-in, one-section, (1) stainless steel door with lock, cam-lift hinges, color-coded temperature display, interior lighting, stainless steel front & sides, stainless steel interior, stainless steel ramp, 2.0kW, 115/208-230v/60/1-ph, NEMA 14-20P (accommodates 27"W x 29"D x 66"H cart, NOT included), cULus, UL EPH Classified, Made in USA

2 ea	7 years parts warranty, 7 year labor warranty, standard. Visit www.truemfg.com for specifics.
2 ea	Thermometer side: Door hinged on right standard

ITEM 19 - ROLL-IN REFRIGERATOR (1 REQ'D)
True Mfg. - General Foodservice Model STR2RRI-2S

SPEC SERIES® Refrigerator, roll-in, (2) stainless steel doors with locks, cam-lift hinges, digital temperature control, incandescent interior lighting, stainless steel ramps, stainless steel front & sides, stainless steel interior, 1/2 HP, 115v/60/1-ph, 11.8 amps, NEMA 5-15P, (accommodates 27"W x 29"D x 66"H carts, NOT included), cULus, UL EPH Classified, Made in USA

1 ea 7 year compressor warranty, 7 years parts warranty, 7 year labor warranty, standard. Visit www.truemfg.com for specifics.

1 ea Left door hinged left, right door hinged right standard

ITEM 20 - SERVING COUNTER (2 REQ'D)

Custom Model -

Custom Serving Counter to be constructed size and shape as shown. Countertop to be 14 gauge stainless steel to overhang body 1 " on back side. Top reinforced with 1 1/2" x 1 1/2" x 1/8" hot rolled steel angle iron frame studded to underside and welded to cabinet body. Underbracing not to exceed 30" centers. Counter body to be constructed of 18 gauge, type 304, stainless steel. Counter to be 34" high with tray slide at 32" A.F.F. to comply with ADA requirements, with body enclosed on front and ends. Counter to be mounted on 6" high stainless steel legs.

Utilities: None.

Installation Notes: Set-in-place as shown on plans.

ITEM 20.1 - SNEEZE GUARD (2 REQ'D)

Custom

Sneeze Guard as per detail- See detail

ITEM 21 - HOT FOOD WELL UNIT, DROP-IN, ELECTRIC (2 REQ'D)

APW Wyott (Middleby) Model HFW-3DS

Hot Food Well Unit, drop-in, electric, (3) 12" x 20" wells, wet or dry operation, infinite controls, EZ lock, insulated, with drain, stainless steel wells, UL, NSF

2 ea 1 year parts & labor warranty, standard

2 ea 208v/240v/60/3-ph, standard

6 ea Model 21709 Drain Screen, Fits all models with drains, one per well required

ITEM 22 - MILK COOLER (1 REQ'D)

True Mfg. - General Foodservice Model TMC-49-DS-HC

Mobile Milk Cooler, forced-air, (12) 13" x 13" x 11-1/8" crate capacity, dual sided stainless steel drop front/hold-open flip-up lids with locks, 33 - 38°F temperature range, (3) heavy-duty floor racks, digital thermometer, white vinyl exterior, aluminum interior with stainless steel floor, R290 Hydrocarbon refrigerant, 4" castors, 1/5 HP, 115v/60/1-ph, 2.7 amps, NEMA 5-15P, cULus, UL EPH Classified, Made in USA, ENERGY STAR®

1 ea 7 year compressor warranty, 7 years parts warranty, 7 year labor warranty, standard. Visit www.truemfg.com for specifics.

1 ea Self-contained refrigeration standard

1 ea 4" Castors, standard

ITEM 23 - PLANETARY MIXER (1 REQ'D)

Hobart Model HL200-1STD

100-120/50/60/1; Bench type mixer; with bowl, beater, whip & spiral dough arm, US/EXP configuration - Legacy Planetary Mixer, Bench, 20 quart, (3) fixed speeds plus stir speed, gear-driven transmission, 15-minute SmartTimer™, #12 taper hub, manual bowl lift, stainless steel bowl, aluminum "B" beater, stainless steel "D" wire whip, aluminum "ED" spiral dough arm, stainless steel bowl guard, 1/2 hp, cord with plug

1 ea Standard warranty - 1-Year parts, labor & travel time during normal working hours within the USA
1 ea Model TABLEHW-HL2012 Mixer Table; 27”W x 32”D x 26”H, the top shelf is drilled for mounting an HL120 or HL200 mixer, includes 4 posts for storing attachments, a lower shelf for additional storage, & (4) locking 5” diameter wheels

ITEM 24 - WORK TABLE, STAINLESS STEEL TOP (1 REQ'D)
Advance Tabco Model TKSS-367
Work Table, 84"W x 36"D, 14 gauge 304 stainless steel top with 5"H backsplash, stainless steel legs with side & rear crossrails, adjustable stainless steel bullet feet, NSF
4 ea Cambro Model IBS27148 Ingredient Bin, mobile, 27 gallon capacity, 1-pc seamless polyethylene bin, 2-pc sliding polycarbonate lid, scoop holder included (scoop sold separately), (4) 3" heavy duty casters (2 front swivel, 2 fixed), white with clear cover, NSF

ITEM 25 - PLANETARY MIXER (1 REQ'D)
Hobart Model HL300-1STD
200-240/50/60/3 Mixer; with bowl, beater, & “D” whip; US/EXP configuration - Legacy Planetary Mixer, 3/4 hp, 30 quart capacity, (3) fixed speeds, gear-driven transmission, 15-Minute SmartTimer™, #12 taper attachment hub, manual bowl lift, bowl guard, stainless steel bowl, "B" beater, "D" whip
1 ea Standard warranty: 1-Year parts, labor & travel time during normal working hours within the USA

ITEM 26 - DOUGH DIVIDER (1 REQ'D)
Dutchess Bakers Model BMIH-36/9
Dough Divider, manual, includes (2) interchangeable head assemblies: 9-part (4 oz. - 17 oz. pieces) & 36-part (1 oz. - 4 oz. pieces), includes stainless steel pan, NSF, USDA
1 ea 2 years parts & labor warranty, standard
1 ea Model B4-436-0072 Portable Stand with shelf for BMIH models

ITEM 27 - THREE (3) COMPARTMENT SINK (1 REQ'D)
Advance Tabco Model 94-83-60-36RL
Regaline Sink, 3-compartment, with left & right-hand drainboards, 28" front-to-back x 20"W sink compartments, 14" deep, with 11"H backsplash, stainless steel legs with adjustable left-to-right and front cross rails, 36" drainboards, 1" adjustable bullet feet, 14 gauge 304 stainless steel, overall 36" F/B x 139" L/R, NSF
3 ea Model K-15 Lever Waste Drain, twist handle operated with built in overflow, fits 3-1/2" drain opening, 2" NPT & 1-1/2" IPS outlet connections
3 ea Model K-4 Support Bracket, for lever waste drain handle, (1) support required for each lever drain

ITEM 27.1 - WALL / SPLASH MOUNT FAUCET (1 REQ'D)
T&S Brass Model B-0231
Sink Mixing Faucet, wall mount, 8" centers, 12" swing nozzle, lever handles, quarter-turn Eterna cartridges, 1/2" NPT female inlets, low lead, ADA Compliant

ITEM 27.2 - PRE-RINSE FAUCET ASSEMBLY, WITH ADD ON FAUCET (1 REQ'D)
T&S Brass Model B-0133-01-CR
EasyInstall Pre-Rinse Unit, wall mount mixing faucet, 8" adjustable centers, 56" flexible stainless steel hose, 1.15 GPM spray valve (B-0107), 14" EasyInstall add-on swing faucet with stream regulator outlet, quarter-turn Cerama cartridges with check valves, lever handles with color-coded indexes, 18" riser, 9" wall bracket, polished chrome-plated brass faucet body, 1/2" NPT female inlets, low lead

ITEM 28 - OVERSHELF (1 REQ'D)
Advance Tabco Model PS-12-72
Shelf with Pot Rack, wall-mounted, 72"W x 12"D, 18/430 stainless steel shelf, 2" x 1/4" stainless steel pot rack, includes: (9) plated double pot hooks, NSF

ITEM 29 - ONE (1) COMPARTMENT SINK (1 REQ'D)
IMC/Teddy Model DL-2
Utensil/Can Washer, 16 gauge #304 stainless steel construction., one-piece wash basin, 1" OD stainless steel tubing wash supports, fully welded, removable scrap drawer, integrated 12" backsplash, double foot pedal valve, return-mounted faucet, with 48" flexible stainless steel hose & spray head
1 ft Model RSS8 side & rear splash, 8" high, (priced per foot)

ITEM 30 - MOP SINK BY MECHANICAL (1 REQ'D)
Mechanical
Mop sink by mechanical

ITEM 31 - DISHWASHER, CONVEYOR TYPE (1 REQ'D)
Hobart Model CL54-BAS+BUILDUP
Conveyor Dishwasher, single tank, (245) racks/hour, .47 gallon/rack, Complete Delime with Booster Guard, Touch Screen Controls with diagnostics, troubleshooting, and SmartConnect App, capless wash arms, NSF Pot & Pan mode, pumped rinse, insulated hinged doors, cULus, NSF, ENERGY STAR®, Factory Startup - Free for installations within 100 miles (accessible by public roadway) of a Hobart Service Office during normal business hours with appropriate notice; Installation beyond 100 miles or those not accessible by public roadway will be quoted by Service.

THIS UNIT IS SPECIAL ORDER WITHOUT HOBART BOOSTER HEATER. THE DISTRICT HAS REQUESTED A HUBBEL BOOSTER HEATER

1 ea Oversized units with crated shipping dimensions greater or equal to 72" in length and/or 90" in height. If delivery is to a facility without a standard height dock, additional shipping charges will apply depending on the service requested. consult Factory.
1 ea Standard warranty - 1-Year parts, labor & travel time during normal working hours within the USA
1 ea Model CL54BAS-ELE0AX 208v/60/3-ph
Single point connection standard (field convertible to dual point)
1 ea Model CL54BAS-HGTSTD Standard Height 19.5”H x 22”W opening, fits full-sized sheet pan, horizontal
1 ea Model CL54BAS-HTE15K Electric tank heat 15kW
1 ea Model CL54BAS-DIR0RL Right to left operation
1 ea Model TBLLIM-CL Table limit switch for CL & CLEN series
1 ea Model CL54EN-BASFETSTD Standard feet

ITEM 32 - SOILED DISHTABLE "L" SHAPED WITH PASS THRU WINDOW (1 REQ'D)
Custom Model SOILED DISHTABLE
Soiled dishtable with Pass thru window
Size shape per plan Construction to be in accordance with NSF standard No. 2
Top to be fabricated to 14 gauge, type 304, stainless steel with a No.4 polished finish. Cove all corners on 5/8" radius. Front edge to have 3" high rolled rim. Edges adjacent to walls to have 10" high backsplash with 2" return at 45 degrees to wall an flanged down 3/4". Top to be reinforced with 1 1/2"x1 1/2"x1/2" hot rolled steel angle studded to underside. Underbracing not to exceed 30" centers. Tables to be supported on 1 5/8" O.D. stainless steel tubular legs fitted with NSF approved adjustable bullet feet of like material. Legs to fit in sanitary, die-stamped, reinforced stainless steel gussets, welded to 12 gauge stainless steel triangle gusset plates. Gusset Plates to be heliarc welded to top. Cross rails of 1 5/8" O.D., 16 gauge stainless steel tubing to be heliarc welded in place 10" above floor with welds ground smooth. Leg sections not to exceed 65" centers. Quick drain trough with perf. insert. 5" wide x 24" long x

1" deep. 14 gauge, type 304 stainless steel coved corner construction. Dishtable to extend thru pass-window with marine edge on opening. Window opening to be cased with stainless steel.
Utilities: 1 1/2" indirect waste to floor sink
Installation Notes:
Set & Level as Per Plan
Clip and seal splash to wall.

ITEM 32.1 - PRE-RINSE FAUCET ASSEMBLY (1 REQ'D)
T&S Brass Model B-0133
EasyInstall Pre-Rinse Unit, wall mount mixing faucet with 8" adjustable centers, quarter-turn Eterna cartridges with spring checks, lever handles with color-coded indexes, 18" EasyInstall riser, 44" flexible stainless steel hose with heat-resistant gray handle & hold down ring, 1.15 GPM spray valve (B-0107), finger hook, polished chrome-plated brass faucet body, 1/2" NPT female inlets, CSA

ITEM 33 - CLEAN DISHTABLE (1 REQ'D)
Custom Model CLEAN DISHTABLE
Dishtable, clean, straight design, attaches to LEFT of dish machine operator, 10-1/2"H backsplash, 3" rolled front & side rims, stainless steel legs & crossrails, 71"W x 30"D x 34"H, 14/304 stainless steel
Provide with undershelf as shown on plans.

Provide with undershelf as per plan.

ITEM 33.1 - DISHTABLE SORTING SHELF (1 REQ'D)
Advance Tabco Model DT-6R-13
Sorting Shelf, wall mounted, traditional design, 62"W, accommodates (3) full size dish racks, solid end brackets, stainless steel, NSF

ITEM 34 - WASTE COLLECTOR (1 REQ'D)
Salvajor Model S914
Scrap Collector™, scrapping, pre-flushing & collecting system (widely accepted in areas where disposers are restricted), NEMA 4 HYDROLOGIC® control panel with patented operator sensor, two water saving modes (timed run & auto start/stop), safety line disconnect, LCD readout, salvage basin & silverware trap, scrap basket, 3/4 HP corrosion-resistant pump, pump intake screen, stainless steel construction, UL, CSA, CE, NSF
1 ea Collector top is available to ship to the fabricator in advance of unit (additional shipping charges will apply). Please provide instructions on order
1 ea 208v/60/1-ph, 5.5 amps

ITEM 35 - CASH REGISTER STAND (1 REQ'D)
Cambro Model VCSWRHD110
Versa Cash Register Cart, 52-3/4"L x 32"W x 43-3/4"H, lockable center drawer, adjustable shelf and rails, cut out design, will not dent, crack or rust, one-piece, seamless, double-wall polyethylene, polyurethane foam insulation, molded-in handles, non-electrical, (4) heavy duty 6" swivel casters with brakes, black, NSF
1 ea Model VCS32KEYT110 Versa Cart Keyboard Tray, black, NSF

ITEM 36 - SERVING COUNTER, COLD FOOD (1 REQ'D)
Cambro Model VBR5110
Versa Food Bar™ Serving Buffet, cold food, 5 ft. unit, 69"L x 42-1/2"W x 62-3/4"H, holds (4) full size pans, accommodates various size food pans up to 6", cooled with optional Camchillers® or ColdFest®,

double-wall polyethylene, molded-in handles, threaded faucet drain, non-electrical, (4) 6" swivel casters with brakes, black, NSF

ITEM 37 - UNIVERSAL PAN RACK (6 REQ'D)
Cres Cor Model 2736512/1818
Rack, roll-in refrigerator, extruded angle ledge pan supports welded to frame, (18) 18" x 26" trays or (18) 12" x 20" pans capacity, 3" centers, aluminum extruded angles welded in place on 3" centers, fully welded Hi-Tensile aluminum frame construction, (4) 5" swivel casters (2) braked, NSF
6 ea Standard Warranty: 3 year parts, 1-year labor warranty, lifetime guarantee against rust & corrosion

ITEM 38 - SHELVING, DRY STORAGE (7 lt REQ'D)
Metro
Super Adjustable Super Erecta® wire shelving, chrome plated finish, corner release system, NSF
5 ea Model 2448NC Quick Ship - Super Erecta® Shelf, wire, 48"W x 24"D, chrome plated finish, plastic split sleeves are included in each carton, NSF
30 ea Model 2460NC Quick Ship - Super Erecta® Shelf, wire, 60"W x 24"D, chrome plated finish, plastic split sleeves are included in each carton, NSF
28 ea Model 74P Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", chrome finish

ITEM 39 - DUNNAGE RACK (4 REQ'D)
Metro Model HP2248PD
Quick Ship - Metro Bow-Tie™ Dunnage Rack, 22" x 48" x 12"H, slotted, with separate polymer tie for joining racks, corrosion proof polymer construction, NSF

ITEM 40 - SHELVING, WALK-IN (13 lt REQ'D)
Metro Model -
Shelving, walk-in
8 ea Model 2436NK3 Quick Ship - Super Erecta® Shelf, wire, 36"W x 24"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
4 ea Model 2448NK3 Quick Ship - Super Erecta® Shelf, wire, 48"W x 24"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
36 ea Model 2460NK3 Quick Ship - Super Erecta® Shelf, wire, 60"W x 24"D, Metroseal™ Green epoxy-coated corrosion-resistant finish with Microban® antimicrobial protection, plastic split sleeves are included in each carton, NSF
52 ea Model 63PK3 Quick Ship - Super Erecta® SiteSelect™ Post, 62-7/16"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", Metroseal 3 Green epoxy coated corrosion-resistant finish with Microban® antimicrobial protection
52 ea Model 5MPB Quick Ship - Super Erecta® Stem Caster, swivel (with foot operated brake), 5" dia., 1-1/4" face, 300 lb. capacity, polyurethane flat wheel tread, includes bumper

ITEM 41 - LOUVERED SLOTTED SHELVING (2 REQ'D)
Metro Model 2460LS
Super Erecta® Shelf, 60"W x 24"D, stainless steel, louvered embossed, raised "ship's edge" on all (4) sides, aluminum castings lock corners to posts
8 ea Model 74PS Quick Ship - Super Erecta® SiteSelect™ Post, 74-1/2"H, adjustable leveling bolt, posts are grooved at 1" increments & numbered at 2" increments, double grooved every 8", type 304 stainless steel

ITEM 42 - CORNER GUARD (19 REQ'D)
Custom Model CORNER GUARDS

CORNER GUARDS, 16 GAUGE 304 STAINLESS STEEL, 3" X 3" X 72" LONG, 3" X WALL

WIDTH X 3" X 72" LONG PER DETAILS.

UTILITIES: NONE

INSTALLATION NOTES: PROVIDE AT ALL OUTSIDE WALL CORNERS IN KITCHEN AREA.

ATTACH TO WALL AS REQUIRED AS PER PLAN.

END OF SECTION 11 4000

SECTION 11 6143

STAGE CURTAINS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.

1.03 SUMMARY

A. This Section includes the following types of stage curtains:
   1. Front-setting curtains including front curtain.
   2. Intermediate-setting curtains including valance, and intermediate legs.

B. Related Sections: The following Sections contains requirements that relate to this Section:
   1. Division 11 Sections for stage equipment.
   2. Division 26 Sections for electrical wiring, connections, and installing remote control switches for draw curtain machines.

1.04 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data, installation instructions, and general recommendations, including data substantiating that materials comply with requirements.

C. Shop drawings including plans, elevations, and detail sections of typical rigging elements. Show anchors, hardware, operating equipment, and other components not included in manufacturer's standard product data.

D. Samples for verification purposes, 12 inches square of each fabric in color indicated and with flameproofing applied.

E. Product certificates signed by stage curtain fabricator certifying that the products comply with specified requirements.

1.05 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: Firm experienced in producing stage curtains similar to those indicated for this Project that have a record of successful in-service performance, and with sufficient production capacity to produce required units without causing a delay in the Work.

B. Fire-Performance Characteristics: Provide stage curtains that are certified to be flame resistant according to requirements of NFPA 701. Permanently attach label to each curtain indicating whether curtain is permanently and inherently flame resistant, or whether it will require retreatment after dry cleaning.

1.06 PROJECT CONDITIONS

A. Field Measurements: Check actual stage curtain openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying Work.

1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabricating stage curtains without field measurements. Coordinate stage construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 PRODUCTS

2.01 FRONT-SETTING FABRIC

A. Woven Cotton Velour: Napped fabric of 100 percent cotton; 54-inch minimum width; not less than 40 backing ends per inch, 40 pile ends per inch, and 32 picks per inch; 640 pile tufts per square inch; and other characteristics as follows:
   1. Weight: Fabric weighing not less than 24 oz. per linear yard before flameproofing, with pile height of approximately 135 mils.

B. Lining: Yarn-dyed denim cloth of 100 percent cotton, woven in a warp-faced twill; 54-inch minimum width.

C. Colors: Where manufacturer's standard products are indicated, provide colors complying with the following requirements:
   1. For woven cotton velour, provide colors as follows:
      a. Provide Architect selections from manufacturer's full range of standard colors.

D. Product: Subject to compliance with requirements, provide the following velour fabric:
   1. Memorable, KM Fabrics, Inc.
   2. Velour, Rose Brand, NY, NY.
   3. Velour, Fox-Rich Textiles, Inc. Ridgefield, CT.

2.02 INTERMEDIATE-SETTING FABRIC

A. Duvetyn: 100 percent cotton short-napped fabric, twill weave with soft uniform texture, weighing not less than 8 oz. per linear yard before flameproofing; 54-inch minimum width.

B. Colors: Where manufacturer's standard products are indicated, provide colors complying with the following requirements:
   1. Provide Architect's selections from manufacturer's full range of standard colors, (black anticipated).

2.03 METAL

A. Steel Pipe: ASTM A 53, Grade A, black, standard weight (Schedule 40), 1-1/2-inch nominal diameter, unless otherwise indicated.

B. Galvanized Steel Sheet: Zinc-coated carbon steel sheet of commercial quality, complying with ASTM A 526, G60 zinc coating; 0.075-inch (14-gage) minimum nominal thickness.

C. Supports, Clamps, and Anchors: Sheet steel in manufacturer's standard gages, galvanized after fabrication according to ASTM A 153, Class B.

D. ASTM A 413, 1/4-inch size, not less than 0.276-inch material diameter. (Consult bid documents, use this chain to suspend the devices, if selected by bid)

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units.

2.04 CURTAIN FABRICATION

A. General: Provide not less than 100 percent additional fullness for front setting curtains, and 75 percent fullness for other curtains, unless otherwise indicated. Provide vertical seams unless otherwise indicated. Do not use fabric cuts less than half width. Fabricate velour curtains with the nap down.
   1. Vertical Hems: Provide vertical hems not less than 2 inches wide, with a 1-inch tuck, and machine-sewn with no selvage material visible from front of curtain. Sew open ends of hems closed.

2. Leading Edge Turnbacks: Where specified, provide turnbacks formed by folding 12 inches of face fabric back with a 1-inch tuck and secured by sewing the turnback vertically.
3. Top Hems: Reinforce top hems by double-stitching 3-1/2-inch-wide, heavy jute webbing to top edge with minimum 2 inches of face fabric turned under.
4. Pleats: Provide fullness in curtains by sewing additional material into 6-inch double-stitched box pleats spaced at 12 inches o.c. along top hem reinforcing. Provide not less than No. 2 brass grommets, centered on box pleats, for tie lines or S hooks.
   a. Arrange vertical seams so that they do not fall on faces of pleats.
   b. For velour curtains provide not less than No. 3 grommets.
   c. For black curtains provide grommets with a black anodic finish.
5. Bottom Hems: For curtains that do not hang to the floor, provide hems not less than 3 inches deep with 3/4-inch weight tape. For floor-length curtains, provide hems not less than 6 inches deep with 1-inch weight tape. Sew open ends of hems closed.
6. Lining: Provide lining for front curtains in same fullness as face fabric, and finished 2 inches shorter than face fabric. Unless otherwise specified, provide lining constructed of same fiber type as face fabric. Attach lining to face fabric along bottom and side seams with 4-inch-long strips of heavy woven cotton tape.

B. Battens: Fabricate battens from steel pipe with a minimum number of joints. As necessary for required lengths, connect pipe with a drive fit pipe sleeve not less than 18 inches long, and secure with four flush rivets, plug welds, threaded couplings, or another equally secure method. Shop-paint completed pipe battens with good quality black paint with 1-inch-wide yellow stripe at the center of each batten.

2.05 STRAIGHT CURTAIN TRACK FABRICATION

A. Steel Tracks, General: Fabricate of not less than 0.075-inch (14-gage) nominal thickness galvanized roll-formed steel, with continuous bottom slot, and with each half of track in one continuous piece.
   1. Provide curtain carriers for track spaced at 12 inches o.c.

B. Heavy-Duty Track: Use for front curtain, full stage travellers (full width with overlap), and for legs (12 foot lengths for each leg,without rope operaing devices). Equip track with heavy-duty live-end double pulley and heavy-duty dead-end single pulley, with 5-inch cast-iron or nylon wheels on ball bearings, enclosed in steel housings. Provide curtain carriers of molded nylon with a pair of neoprene- or nylon-tired ball-bearing wheels riveted parallel to body. Equip carriers with neoprene or rubber bumper, heavy-duty swivel eye, and trim chain for attaching curtain snap or S hook. Provide end stops for track and adjustable floor block designed to maintain proper tension on 3/8-inch stretch-resistant operating line of braided polypropylene or fiber-glass center cord, and 10 pound sandbag.
   1. Equip carriers with back-pack guide accessory to permit offstage curtain folding.

C. Products: Subject to compliance with requirements, provide one of the following: Heavy Duty Track:
   1. Silent Steel Model No. 280, Automatic Devices Company.
   2. Tru-Roll Model No. 1000, Grosh Scenic Studios, Inc.
   3. Atlas Silk Model No. 400, H & H Specialties, Inc.

PART 3 EXECUTION

3.01 PREPARATION

A. Furnish layouts for inserts, clips, or other supports required to be installed by other trades to support tracks and battens. Coordinate all such work.

3.02 INSTALLATION, GENERAL

A. Install materials according to manufacturer's printed instructions and recommendations.

3.03 BATTEN INSTALLATION

A. Install battens by suspending at proper heights with 4/0 passing link steel chains spaced as indicated.
B. Secure chains either directly to structures or to inserts, eye-screws, or other devices that are secure and appropriate to substrate, and that will not deteriorate or fail with age or elevated temperatures.

3.04 TRACK INSTALLATION

A. Batten-Hung Tracks: Install track by suspending from pipe batten with manufacturer's special pipe clamps at recommended spacing.
    1. Heavy-Duty Track: Do not exceed 6 feet between supports.
B. Install track for center-parting curtains with not less than a 2-foot overlap of track sections at center, supported by special lap clamps.

3.05 CURTAIN INSTALLATION

A. Track-Hung: Secure curtains to track carriers with track manufacturer's special heavy-duty S hooks or snap hooks.
B. Batten Hung: Secure curtains to pipe battens with minimum 5/8-inch-wide by 36-inch-long braided soft cotton tie lines.
C. Revisit the jobsite not less than 90 days after installation is complete to retrim curtains to compensate for stretching.

END OF SECTION 11 6143

SECTION 11 6623

GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Gymnasium Equipment work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Basketball backboards, goals, and support framing (interior).
   1. Glass backboards.
   2. Motorized height adjuster.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete floor slab to receive floor sleeves and anchors.
B. Section 05 1200 - Structural Steel Framing: Structural members supporting basketball systems.
C. Section 05 5000 - Metal Fabrications: Secondary structural members supporting gymnasium equipment.
D. Section 09 6463 - Wood Athletic Flooring: Layout and painting of court lines to be coordinated with installation of floor sleeves and anchors.
E. Division 26 - Electrical: Equipment wiring.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2016.
B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
D. ASTM A391 / A391M - Standard Specification for Grade 80 Alloy Steel Chain; 2012.
E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).
F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
G. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
H. ASTM B179 - Standard Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes; 2018.
I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
L. NFHS (Guide) - Court and Field Diagram Guide; current edition.
M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. PS 1 - Structural Plywood; 2009 (Revised 2019).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.
B. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1.05 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Provide basketball backboards capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures".

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
    1. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
    2. Electrical characteristics and connection locations.
    3. Fire rating certifications.
    4. Structural steel welder certifications.
    5. Manufacturer's installation instructions.
C. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gage of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.
D. Erection Drawings: Detailed dimensional requirements for proper location of equipment.
E. Samples: Submit samples of wall pad coverings in manufacturer's available range of colors and textures.
F. Operating and maintenance data, for each operating equipment item. Include emergency operations.
G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified with minimum five years of experience, trained and approved by manufacturer.
C. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer. Manufacturer must have local representation.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
E. Composite Wood Products: Made without urea formaldehyde.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.
B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.
C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.09 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.10 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide Manufacturer's Warranties:
    1. Basketball Backstop Structure: 25 years.
    2. Backboards installed with Goal Brace: Lifetime warranty against breakage.
C. The Contractor shall guarantee this work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gymnasium Equipment:
    1. Draper, Inc: www.draperinc.com.
    2. Performance Sports Systems: www.perfsports.com.
    3. Porter Athletic Equipment Company: www.porterathletic.com.
    4. Jaypro Sports
    5. Sports Imports.
    6. Spalding.
    7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL REQUIREMENTS

A. See drawings for sizes and locations, unless noted otherwise.
B. Where mounting dimensions or sizes are not indicated, comply with applicable requirements of the following:
    1. National Federation of State High School Associations NFHS (Guide) sports rules.
C. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of Contract Documents.
D. Hardware: Heavy duty steel hardware, as recommended by manufacturer.
E. Electrical Wiring and Components: Comply with NFPA 70; provide UL-listed equipment.
F. Structural Steel Fabrications: Welded in accordance with AWS D1.1/D1.1M , using certified welders.

2.03 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Profiles, and Tubes: ASTM B221.
2. Cast Aluminum: ASTM B179.

B. Steel: Comply with the following:
1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2. Steel Tubing: ASTM A500/A500M or ASTM A513/A513M, cold formed.

C. Support Cable: Manufacturer's standard galvanized steel aircraft cable with a breaking strength of 7000 lb. Provide fittings complying with cable manufacturer's written instructions for size, number, and method of installation.

D. Support Chain and Fittings: Grade 80 hardened alloy steel chain rated for overhead lifting, ASTM A391 / A391M, with commercial-quality, zinc-plated steel connectors and hangars.

E. Castings and Hangers: Malleable iron, ASTM A47/A47M, grade required for structural loading.

F. Softwood Plywood: APA PS 1, exterior.

G. Particleboard: ANSI A208.1

H. Equipment Wall-Mounting Board: Wood, transparent finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.

I. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units.

J. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M with minimum strength recommended in writing by gymnasium equipment manufacturer.

2.04 BASKETBALL EQUIPMENT

A. Manufacturers:
1. ADP-Lemco, Inc: www.adplemco.com.
2. Performance Sports Systems: www.perfsports.com.
3. Porter Athletic Equipment Company: www.porter-ath.com.
4. Spalding Equipment: www.spaldingequipment.com.
5. Draper, Inc: www.draperinc.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. All components including framing, backboard, goals, electric winches, controls, and accessories for basketball backstop assemblies shall be products of a single manufacturer.

C. Multipurpose Room:
1. Backstop: Ceiling Suspended, Forward Folding, Rear Braced Basketball Backstop.
a. Distance from court floor to backstop attachment at roof structure: As indicated on Drawings.
b. Main frame: Rigid T design of back-to-back right triangles constructed by welding together steel tubing of the following outside diameters and gages.
1) Main center stem: 6 inches (152 mm) diameter, 11 gage (3.2 mm thick) of length sufficient to allow backstop height adjustment of plus or minus 6 inches (152 mm).
2) Top member of T frame: 4 inches (102 mm) diameter, 11 gage (3.2 mm).
3) Folding rear brace: Jackknife type, fully adjustable, self-locking with positive latch in down position constructed from 2-1/2 inches (64 mm) diameter, 13 gage (2.4 mm thick) outer tube and 2-1/4 inches (57 mm) diameter, 14 gage (2 mm) inner tube.
4) Diagonal side braces: 2-1/4 inches (57 mm) diameter, 14 gage (2 mm thick).
c. Pivot point: 1-1/4 inches (32 mm) diameter solid steel shaft and 1/2 inch (13 mm) steel plate hangers.
d. Acceptable Product: Model EZ Fold TF-20J as manufactured by Draper, Inc.
2. Electric Winch: Fully enclosed, direct drive, worm gear, electric winch designed to hold backstop at any position during raising and lowering.

a. Motor: 1 HP, 13.2 AMP, capacitor type, 60 cycle, 110 volt, single phase with automatic thermal overload protection manufactured in compliance with NEMA specifications.
b. Hoist cable: 1/4 inch (6 mm) diameter, 7 by 19, galvanized aircraft cable with 7,000 pounds (3175 kg) ultimate breaking strength.
c. Roller: Spring-load providing tensioning pressure to ensure cable tracks evenly on grooved drum.
d. Limit switches: Rotary counting up and down type, pre-wired to motor as integral part of winch.
e. Controls: Provide key lock, 3 position, momentary contact wall control switch to lower, raise, and stop backstop.
    1) Provide two keys, one controlling up direction and second controlling down direction.
    2) Provide with stainless steel cover plate.
f. Acceptable Product: Model 503085 Motorized Winch as manufactured by Draper, Inc.

3. Safety Belt and Lock: Safety belt and lock tested to withstand 1000 pounds (454 kg) free fall load.
    a. Safety lock: Inertia sensitive to automatically lock backstop in position at any time during storage, raising, or lowering. Sudden increase in either tension or speed shall activate lock.
    b. Safety belt: 2 inches (51 mm) wide nylon belt rated at 6000 pounds (2721 kg) breaking strength.
    c. Belt shall extend 35 feet (10.7 m) and shall be automatically retracted and stored on reel equipped with constant force spring. Operation and locking action shall be activated by centrifugal force to lock backstop before unit travels 12 feet (3.7 m) of free fall.
    d. Unit shall incorporate automatic reset not requiring poles, ropes, levers, or buttons for resetting.
    e. Acceptable Product: Posilock Safety Belt 503029 as manufactured by Draper, Inc.
4. Backboard: Rectangular, glass, official size backboard.
    a. Size: 72 inches (1829 mm) wide by 42 inches (1067 mm) high.
    b. Finish: Factory applied, white, high gloss gel finish with molded-in orange border and target lines.
    c. Acceptable Product: Glass Model 503136 as manufactured by Draper, Inc.
5. Goals: Breakaway goal with tube-tie net attachment and designed to withstand shock loads from player slam dunking or hanging on rim.
    a. Rim shall deflect down when 230 pounds (104 kg) static load is applied and return to playing position when load is removed. Breakaway point shall be adjustable form 160 to 230 pounds (73 to 104 kg).
    b. Ring shall have rebound characteristics identical to those of non-moveable ring. Factory set proper flex and rebound requirements.
    c. Ring: Fabricated from 5/8 inch (16 mm) diameter steel rod formed into 18 inch (457 mm) ring. Rigidly brace with die cut steel braces welded to rim.
    d. Mounting plate: Heavy duty steel plate bracket with mounting holes and designed to position inside of ring 6 inches (152 mm) from backboard.
    e. Provide series of small tubes welded to bottom of rim providing for attachment of net by threading 9 gage (3.7 mm diameter) wire through tubes.
    f. Finish: Powder coated orange paint.
    g. Anti-whip net: Top half made of durable fibers encased in nylon to prevent net from whipping up on rim. Lower half all nylon. Color white.

h. Mounting hardware: Zinc plated.
i. Acceptable Product: Model 503581 as manufactured by Draper, Inc.

6. Safety Edge Padding: Foam padding for bottom edge and corners of backboard to provide safety protection.
   a. Construction: Molded foam, 2 inches (51 mm) wide and wrapping around edges 3/4 inch (19 mm). Equip with molded-in steel track and bolt-on attachment system. Padding shall cover bottom edge of backboard and extend 15 inches (381 mm) up sides.
   b. Color: As selected by Architect from manufacturer's standard colors.
   c. Acceptable Product: Model 5032XX Bolt-On Safe-Edge Padding as manufactured by Draper, Inc.

D. Materials:
   1. Structural steel tubing finished to match painted structure: Steel, mechanical, round tubing conforming to ASTM A500/A500M.
   2. Clamps:
      a. Beam Clamps: Split-A type with 7 square inches (4516 square mm) minimum beam flange contact area and secured with 2 all thread bolts at each attachment point. Clamps shall be designed to be capable of supporting a minimum of 20,000 Lbs. each. Superstructure shall be designed with a minimum of four attachment clamps to produce a combined minimum attachment point safety factor of 75 to 1. Superstructure tubes shall be reinforced with bridging and/or bracing when truss centers exceed 10 feet (3 m).
      b. Component Attachment clamps: Full surface type fabricated from 1/4 inch (6 mm) thick steel or saddle style utilizing serrated clamping surface and minimum 5/8 inch (16 mm) U-Bolt.
      c. Goal Brace: Type attaching behind goal mounting plate and directly to backstop main stem transferring load directly to structural frame.

E. Accessories: Provide backstop with backstop hangers, clamps, brackets, fasteners, and all other hardware required for complete, functional, rigid assembly and installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.
B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.
C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.
D. Verify that electrical services are correctly located and have proper characteristics.

3.02 INSTALLATION

A. Install in accordance with Contract Documents and manufacturer's instructions.
B. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.
C. Install equipment rigid, straight, plumb, and level.
D. Secure equipment with manufacturer's recommended anchoring devices.
E. Separate dissimilar metals to prevent electrolytic corrosion.
F. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.
G. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.

H. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.
   1. Floor Insert Location: Coordinate location with application of game lines and markers.
   2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation of finish flooring and type of floor plate.
   3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

I. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.

J. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.

K. Connections: Connect automatic operators to building electrical system.

3.03 CLEANING

A. Remove masking or protective covering from finished surfaces.

B. Clean equipment in accordance with manufacturer's recommendations.

3.04 DEMONSTRATION

A. Demonstrate to Owner's designated representative complete operation and required maintenance for folding basketball backstops.

B. Submit operation and maintenance manuals in accordance with Section 01 7800 - Closeout Submittals.

END OF SECTION 11 6623

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SECTION 11 6633

ROLL-UP GYMNASIUM DIVIDER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Provide all labor, materials, equipment, tools and services required to fully complete all Roll-Up Gymnasium Divider work as is indicated on the drawings or specified herein including, but not limited to, the following described items.
B. Electrically operated fabric gymnasium divider.
C. Do not include sales tax, refer to 00 0104 - Notice to Contractors.

1.02 RELATED SECTIONS

A. Section 05 1200 - Structural Steel Framing: Framing to support gymnasium divider.
B. Division 26 - Electrical: Electrical supply, conduit, and wiring for motorized gymnasium divider.

1.03 REFERENCES

A. NEMA MG 1 - Motors and Generators 2018.
B. NFPA 265 - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
    1. List of proposed products and product data.
    2. Loads to be transmitted to building structural members and requirements for supplementary bracing and structural support members.
    3. Shop drawings (6 copies) showing layout, elevations, dimensions, fabrication details, method of attachment, and electrical wiring diagrams.
    4. Samples of fabric for selection by Architect.
    5. Manufacturer's installation and maintenance instructions.
    6. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer

1.05 QUALITY ASSURANCE

A. Source Limitation: All components including curtain, suspension system, electric winches, and controls for divider shall be products of a single manufacturer.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Do not deliver divider until building is enclosed and other construction within gymnasium is substantially complete.

1.07 GUARANTEE

A. The Contractor shall guarantee this work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roll-Up Gymnasium Divider:

1. Porter Athletic Equipment Company: www.porter-ath.com.
2. ADP Lemco, Inc.: www.adplemco.com.
3. Institutional Products, Inc.: www.instprod.com.
4. Spalding Equipment: www.spaldingequipment.com.
5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GYMNASIUM DIVIDER

A. Basis-of-Design Product: Subject to compliance with requirements, provide ADP Lemco Fold-Up Divider Curtain, Model 6500, or a comparable product by one of the following:
   1. Draper Inc.
   2. Performance Sports Systems.
   3. Porter Athletic Equipment.
   4. Spalding.

B. Overhead Superstructure:
   1. Gym curtain is supported from the roof structure by directly attaching to the underneath side of the roof truss or by attaching to Uni-strut, 4/O Chain, or 3-1/2" OD horizontal and 2-3/8" OD vertical structural tubing supplied by ADP Lemco. Bridge pipe will be required when truss spans exceed 14'. Superstructure shall be furnished with standard black finish.

C. Material:
   1. The lower section shall be solid 19 oz. polyester reinforced, fire retardant and mildew resistant vinyl fabric. Seams shall be electronically welded with a full contact weld. A padded pocket shall be formed in the bottom edge of the curtain to accommodate a 1-7/8" O.D. bottom support pipe. Upper portion of curtain shall be a 9-oz. vinyl coated polyester mesh. A pocket shall be formed in the top edge to accommodate a 1-7/8" O.D. top support pipe. Curtain shall stop 2" above the finish floor.
      a. Two with solid vinyl up 4' and one with vinyl up 8'
      b. Material Colors: As selected by Architect from manufacturer's standards.

D. Drive/Support Structure:
   1. The curtain shall be operated by an ADP Lemco curtain hoist. The curtain hoist shall drive a continuous 2-3/8" O.D. drive shaft. The curtain shall be lifted by means of 1/8" galvanized aircraft cable. Lift cables shall be spaced at no greater than 12'-0" center to center. The cable shall pass through grommets in the vinyl fabric spaced 24" center to center and be taken up on individual reels located on the drive shaft.
   2. The drive shaft shall be supported by a carrier assembly spaced no greater than 12'-0" center to center. The carrier shall consist of a formed bracket with two rubber wheels on which the drive shall rotate.

E. Motor Data:
   1. 1 HP, 120 Volt, Single Phase with Key Switch and Receptacle.
      a. Key to District Standards.

F. Accessories:
   1. Compatible hoist is the model 150-K.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate support of gymnasium divider with roof structure to ensure proper distribution of loads and adequacy of attachment points. Ensure that building structure has been designed for loads of specific gymnasium divider to be provided. Provide additional structural framing members as required in accordance with Section 05 1200.

B. Coordinate configuration, size, and installation of gymnasium divider with height, slope and type of building structure and lighting fixtures, mechanical equipment, ductwork, fire-suppression system, bleachers, athletic equipment, and other potential obstructions.
C. Field verify dimensions prior to fabrication.
D. Coordinate electrical requirements for motorized operating mechanism to ensure proper power source, conduit, wiring, and boxes for keyed switches. Prior to installation, verify type and location of power supply.
E. For installations made after wood gymnasium flooring is installed, provide protection and exercise care not to damage flooring.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and shop drawings.
B. Install even and level with curtain hanging 2 inches (50 mm) above floor in down position.
C. Install control switch such that operator has view of complete gymnasium divider during lowering and raising.
D. Adjust limit switches of electric winch to ensure accurate position in both stored and lowered positions.

3.03 TESTING AND DEMONSTRATION

A. Operate divider curtains to ensure proper lifting and lowering. Adjust as required to ensure smooth operation and accurate positioning.
B. Demonstrate to Owner's designated representatives complete operation and required maintenance.

END OF SECTION 11 6633

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SECTION 11 7910

CHANGING TABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Changing Table work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Changing table - height adjustable.

1.02 RELATED SECTIONS

A. Section 06 1000 - Rough Carpentry for wood blocking.
B. Section 09 2117 - Non-Structural Metal Framing for anchoring of table.
C. Division 22 - Plumbing for drain hose assembly connection.
D. Division 26 - Electrical for power.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product data including manufacturer’s product specifications and standard details.
C. Manufacturer's operation and maintenance instructions

1.04 WARRANTY

A. The changing table warranty covers all product components for manufacturing defects for a period of three (3) years from the date substantial completion. A parts repair/labor warranty is in effect for a period of one (1) year from the invoice date.
   1. These warranties do not cover product defects related to improper product assembly or installation, components which have been damaged due to improper user procedure, lack of recommended maintenance, improper cleaning or parts lost after product delivery.
   2. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 CHANGING TABLE

A. Basis-of-Design Product: Pressalit Care Model R8539 Padded Folding Adult Changing Table with integrated safety side rail and optional drain hose, as distributed by Max-Ability; www.max-ability.com, 1-800-577-1555.

2.02 MATERIALS

A. Changing Table: Heavy duty aluminum frame with removable durable 3-piece polyurethane foam mattress. Powder-lacquered stainless steel mounting bracket and anchors. Wall mounted table, folds up to wall with pneumatic counterbalance.
   1. Length: 75.25 inches.
   2. Width: 31 inches.
   3. Adjustable Working Height: 12 inches - 38 inches with safety stop.
   4. Weight Capacity: 440 lbs.
B. Integrated Safety Side Rail: Built-in, hinged operation. Dual safety locks in up position.

PART 3 EXECUTION

3.01 INSTALLATION

A. Preparation:
   1. Coordinate installation with work of other trades. Provide solid blocking for anchoring of table to wall.

B. Installation:
   1. Install in accordance with manufacturer's instructions. Comply with instructions for secure attachment, proper relation to adjacent finished surfaces and proper operation.
   2. Locate changing table as shown on drawings.
   3. Mount hand control in location as shown on drawings.

END OF SECTION 11 7910 11 7910

SECTION 12 2413

ROLLER WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Roller Window Shade work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Manually operated, roll-up fabric interior window shades including mounting and operating hardware.
    1. Locations as indicated on Drawings.
C. Motorized, roll-up fabric interior window shades including motor operator, controls, and mounting hardware.
    1. Locations as indicated on Drawings.
D. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealants for perimeter of shade system.
B. Section 08 4313 - Aluminum Framed Storefronts: Blocking for support of window shade pocket assemblies.
C. Section 08 4413 - Glazed Aluminum Curtain Walls: Blocking for support of window shade pocket assemblies.
D. Section 09 2116 - Gypsum Board Assemblies: Blocking for support of window shade pocket assemblies.
E. Division 26 - Electrical: Electrical supply, conduit, and wiring for motorized window shades.

1.03 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2019.
B. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2002a (Reapproved 2010).
C. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015
D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015
F. UL (DIR) - Online Certifications Directory; Underwriters Laboratories Inc.; current listings at database.ul.com.
G. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product specified, including:
   1. Preparation instructions and recommendations.
   2. Installation and maintenance instructions.
   3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
   4. Storage and handling requirements and recommendations.
   5. Mounting details and installation methods.
   6. Typical wiring diagrams.
C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.
E. Selection Samples: For each finish product specified, two complete sets of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
F. Verification Samples: For each finish product specified, two complete sets of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.
G. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
H. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section and approved by manufacturer.
C. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
D. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
B. Deliver shades to project site in manufacturer's original, unopened, undamaged containers with labels intact.
C. Individually mark shades with room number and opening number.
D. Inspect the materials upon delivery to assure that specified products have been received.
E. Store and handle shades to prevent damage to fabrics, finishes and operators prior to installation.

1.08 FIELD CONDITIONS

A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.09 WARRANTY

A. The Contractor shall guarantee his work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.
B. Manufacturer's Warranty:
   1. Shade Hardware: Ten (10) years
   2. Electronic Control Equipment: Five (5) Years
   3. Fabrics / Shade Cloth: Ten (10) Years
   4. Aluminum and steel coatings: Ten (10) Years
   5. Chain: Ten (10) Years

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer:
   1. Draper, Inc: www.draperinc.com.
B. Other Acceptable Manufacturers:
   1. Shade Techniques, Inc: www.shadetechniques.com.
   2. Mechoshade Systems, Inc.: www.mechoshade.com.
   3. Hunter Douglas Contract: www.hunterdouglascontract.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MANUALLY OPERATED WINDOW SHADES

A. Hardware:
   1. Manual Chain Operator:
      a. Unitized premolded construction, on 71.5 mm x 76 mm (2.875 inch x 3 inch), 12 gage, L shaped, coated steel mounting brackets.
      b. Operator assembly shall allow for continuous front or back-roll fascia across multiple shades without exposed fasteners.
      c. All shade brackets shall be shipped completely assembled from the factory.
      d. Chain operator type, gear reduction operating hardware, manufactured with a precise inertia braking mechanism to stop shade at any desired point of travel
      e. Drive chain to be #10 stainless steel, tested strength of 41 kg (90lb.), to eliminate breakage of chain under normal usage.
      f. Left hand or right operating systems as required.
   2. Mounting assembly shall allow for continuous front or back-roll fascia across multiple shades without exposed fasteners.
   3. Shade roller tube shall be removable from mounting assembly without hardware removal.
   4. All non-metal components shall be self-lubricating.
   5. Shade hardware system shall provide for field adjustment or component replacement without removal of brackets, regardless of mounting location.
   6. Shade hardware shall allow for a bottom-up or a sideways roller tube installation and removal without removing brackets.
B. Roller Tube assembly:
   1. Top roller tube of one piece extruded aluminium tube, with 10 micron thick clear anodized coating, at the manufacturers recommended engineered diameter and wall thickness for maximum allowable deflection of L/700; Mill finish tubes will not be acceptable.
   2. The roller tube shall be extruded with provision made for mechanical engagement with the operator and drive assembly.
   3. The extrusion shall have various channels to accept fabric attachment spline. The spline and slot reinforces the tube and retains the fabric and operating system.

4. The spline will be an extruded vinyl profile, welded to the fabric band or panel, such that removal and re-installation of the fabric panels can occur without removing the roller tube and hardware. Fabric panels must be replaceable on site. Attachment of the fabric to the tube with double sided adhesive tapes, adhesives, staples, or rivets is not acceptable.

C. Hembars:
   1. Aesthetically designed exposed extruded aluminium alloy 6063-T5, custom rectangular shaped, with matching end caps, pre-weighted, to maintain bottom of shade fabric straight and flat. Hembar attached to fabric panel with welded fabric spline.

D. Fasteners:
   1. Non-corrosive to manufacturers recommendations.

E. Aluminum Fascia:
   1. Back/Regular Roll Fascia:
      a. Extruded aluminium alloy 6063-T5, prefinished, 105 mm x 45 mm x 1.6 mm wall thickness (4.13 inch x 1.77 inch x 0.063 inch), custom designed profile to fit onto remoulded end mounting brackets without exposed fasteners.
      b. Fascia shall allow for continuous placement across multiple shades without exposed fasteners.
      c. Fascia shall conceal the mounting hardware, drive mechanism, roller tube, and all fabric rolled on the tube.
   2. Fascia shall not fit snug against side channels to prevent thermal shock to the glazing system.

F. Pockets and Closures:
   1. Shade Pocket: Manufactured from 2.5 mm (0.098 inch) thick aluminium or 1.5 mm (0.059 inch) thick satin coat steel pocket engineered to meet site conditions. Design considerations include, but are not limited to, mounting conditions, wall/ceiling construction, type and quantity of shades in pocket, and shade length, as indicated on the drawings.
   2. Aluminium Closure:
      a. Extruded aluminum alloy, 6063-T5, pre-finished, 82 mm wide x 1.5 mm thickness (3.23 inch x 0.059 inch).
      b. Designed for attachment to the corresponding pocket and/or hardware using an extruded aluminium clip and return angle, both made of 6063-T5 aluminium alloy, without exposed fasteners.

2.03 MOTORIZED WINDOW SHADES

A. Hardware:
   1. Mounting Assembly:
      a. 38 mm by 3 mm by length required (1.5 inch by 1/8 inch thick by length required) aluminium mounting plate.
      b. Mounting plates shall be attached to square HDPE plates, size as required.
      c. All shade brackets shall be shipped completely assembled from the factory.
      d. Motor coupling and end assemblies shall be as per the above angle and plate with an adjustable (Alan key) setscrew, to ensure proper leveling of the system.
      e. Multiple shade panels (bands) being driven by a single motor may be coupled to a maximum angle of 90 degrees.
   2. Mounting assembly shall allow for continuous front or back-roll fascia across multiple shades without exposed fasteners.
   3. Shade roller tube shall be removable from mounting assembly without hardware removal.
   4. All non-metal components shall be self-lubricating.
   5. Shade hardware system shall provide for field adjustment or component replacement without removal of brackets, regardless of mounting location.

6. Shade hardware shall allow for a bottom-up or a sideways roller tube installation and removal without removing brackets.

B. Electrical Shade Motors:
   1. Shade motor located inside the extruded aluminum roller tube with appropriate adaptors to allow for a smooth operation. Lifting capacity with a 30 percent safety ratio and not exceeding 30DB. Shade motor shall be equipped with a disconnect plug at motor lead.
   2. Shade motor shall be an asynchronous unit, start and run, single phase type (125V - 60 Hz, 230V - 50 Hz or 24V), thermally protected, brush-less motor, permanently lubricated bearings and gearbox manufactured from non corrosive metal gears containing a 3 phase planetary gear reducer. Non-metal planetary gear boxes will not be acceptable.
   3. Shade motor shall contain a conical steel disk brake allowing no slippage under high torque.
   4. Shade motor shall be fitted with solid steel adjustable drive extensions, rectangular bar shaped for drive and torque transfer to single or multiple coupled extruded roller tubes.
   5. Motor speed shall range from 12 to 30 RPM and draw 1.1 to 3.4 Amps as selected by the shade manufacturer for proper system operation. Motor lead shall be plenum rated quality.
   6. Shade motor shall be equipped with externally located control wheels which allow exact control of shade limits in raised and lowered positions, preventing over winding of the fabric/shade cloth.
   7. Include all components for proper unit operation.

C. Motor Control System:
   1. Keyed Wall Switches, refer to Electrical Drawings.

D. Roller Tube assembly:
   1. Top roller tube of one piece extruded aluminium tube, with 10 micron thick clear anodized coating, at the manufacturers recommended engineered diameter and wall thickness for maximum allowable deflection of L/700; Mill finish tubes will not be acceptable.
   2. The roller tube shall be extruded with provision made for mechanical engagement with the operator and drive assembly.
   3. The extrusion shall have various channels to accept fabric attachment spline. The spline and slot reinforces the tube and retains the fabric and operating system.
   4. The spline will be an extruded vinyl profile, welded to the fabric band or panel, such that removal and re-installation of the fabric panels can occur without removing the roller tube and hardware. Fabric panels must be replaceable on site. Attachment of the fabric to the tube with double sided adhesive tapes, adhesives, staples, or rivets is not acceptable.

E. Hembars:
   1. Aesthetically designed exposed extruded aluminium alloy 6063-T5, custom rectangular shaped, with matching end caps, pre-weighted, to maintain bottom of shade fabric straight and flat. Hembar attached to fabric panel with welded fabric spline.

F. Fasteners:
   1. Non-corrosive to manufacturers recommendations.

G. Aluminum Fascia:
   1. Back/Regular Roll Fascia:
      a. Extruded aluminium alloy 6063-T5, prefinished, 105 mm by 45 mm by 1.6 mm wall thickness (4.13 inch by 1.77 inch by 0.063 inch), custom designed profile to fit onto remoulded end mounting brackets without exposed fasteners.
      b. Fascia shall allow for continuous placement across multiple shades without exposed fasteners.
      c. Fascia shall conceal the mounting hardware, power and control cables, drive mechanism, roller tube, and all fabric rolled on the tube.

2. Fascia shall not fit snug against side channels to prevent thermal shock to the glazing system.

H. Pockets and Closures:
1. Shade Pocket: Manufactured from 2.5 mm (0.098 inch) thick aluminium or 1.5 mm (0.059 inch) thick satin coat steel pocket engineered to meet site conditions. Design considerations include, but are not limited to, mounting conditions, wall/ceiling construction, type and quantity of shades in pocket, and shade length, as indicated on the drawings.
2. Aluminium Closure:
   a. Extruded aluminum alloy, 6063-T5, pre-finished, 82 mm wide by 1.5 mm thickness (3.23 inch by 0.059 inch).
   b. Designed for attachment to the corresponding pocket and/or hardware using an extruded aluminium clip and return angle, both made of 6063-T5 aluminium alloy, without exposed fasteners.

2.04 FINISHES

A. Aluminum Finishes:
1. All exposed aluminium shall be clear anodized oxide finish according to AA-M12C22A31 to match adjacent window framing.
2. Unexposed aluminium unless otherwise specified: mill finish.

2.05 FABRIC

A. Light-Filtering Fabric:
1. Openness Factor: 1 percent open.
2. Fabric Thickness: 0.027 inches thick.
3. Fabric Weight: 14.6 oz/sq yd.
4. 36% Fiberglass, 64% Vinyl on Fiberglass.
5. Product: Phifer Sheerweave SW2701.

B. Colors: As selected by Architect from manufacturer's full range.
C. Seaming: Seams in fabric to match vertical mullions.

2.06 FABRICATION

A. Shading system components manufactured and assembled allowing for installation techniques to suit project requirements.
B. Finished assemblies shall be, square, true to size and free from distortion, twist, or other defects that could affect their strength, operation or appearance. Factory applied finish shall be uniform, smooth and without blemishes.
C. The fabric shall be colourfast, retain its shape, not be affected by moisture or heat, and shall be non-flammable. Cut fabric to eliminate glare and reflection from shining surfaces while maintaining exterior view. The top of the fabric is retained in recessed spline of the shade roller and the bottom of the fabric is retained by the selected hem.

PART 3 EXECUTION

3.01 PREPARATION

A. Field verify window dimensions prior to fabrication.
B. Coordinate requirements for blocking and structural supports to ensure adequate means for installation of window shades.
C. Coordinate requirements for power supply, conduit, and wiring required for window shade motors and controls.

3.02 INSTALLATION

A. Install work by manufacturer’s skilled tradesmen and installed in strict accordance with manufacturers recommendations.
B. All items installed, plumbed, squared, rigidly coupled and adequately anchored, maintaining uniformed clearances, accurate alignment levels, and parallel with the window plane. Fabric shall not travel more than 3 mm (0.125 inch) in either direction within channels after installation.
C. The solar screen fabric shall be pre-measured and manufactured off-site

3.03 ADJUSTING AND CLEANING

A. Adjust shades and operating components as required to ensure smooth and trouble free operation without binding.
B. Adjust shade to hang flat without buckling or distortion.
C. Clean shades and exposed components.
D. Replace work, which cannot be satisfactorily repaired, adjusted, or cleaned

3.04 TESTING AND DEMONSTRATION

A. Test motorized window shades to verify that controls, limit switches, and other operating components are functional. Correct deficiencies.
B. Test manual window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
C. Demonstrate operation of shades to Owner's designated representatives.

3.05 SCHEDULE - REFER TO DRAWINGS

END OF SECTION 12 2413

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SECTION 14 2400

HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Hydraulic Elevator work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
   1. Passenger type, machine room-less.
B. Automatic Rescue Operation:
   1. Battery operated.
C. Do not include sales tax, refer to Section 00 0104 - Notice to Contractors.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Includes elevator machine foundation, enclosed hoistway, elevator pit, divider beams, overhead hoist beams, grouting thresholds, grouting hoistway entrance frames, and under slab vapor barrier.
B. Section 04 2000 - Unit Masonry: Masonry hoistway enclosure; building-in and grouting hoistway door frames.
C. Section 05 1200 - Structural Steel Framing: Includes hoistway framing, divider beams, overhead hoist beams, and other misc. items.
D. Section 05 5000 - Metal Fabrications: Includes elevator pit ladder, sill supports, divider beams, overhead hoist beams, and other misc items.
E. Section 09 6800 - Carpeting: Floor finish in car.
F. Division 26 Sections for electrical service for elevators to and including fused disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
G. Division 27 Sections for telephone service for elevators.
H. Division 28 Access Control System for security access system equipment used to restrict elevator use.
I. Division 28 Fire Alarm System for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
B. ADAAG - ADA Accessibility Guidelines (ADAAG); 2002.
C. AISC 360 - Specification for Structural Steel Buildings; 2016 (Revised 2021).
D. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).
E. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks; 2017.
F. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors; 2013.
G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
H. ASTM A139/A139M - Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over); 2016.
I. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.

J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
K. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
L. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
M. ASTM B151 / B151M - Standard Specification for Copper-Nickel-Zinc Alloy (Nickel Silver) and Copper-Nickel Rod and Bar; 2013.
N. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, And Rolled Bar; 2018.
O. ASTM B135 - Standard Specification for Seamless Brass Tube; 2010.
P. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
Q. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
R. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
S. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
T. ASTM B455 - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2010 (Reapproved 2017).
U. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2021).
W. ITS (DIR) - Directory of Listed Products; current edition.
X. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
Y. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
Z. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
AA. PS 1 - Structural Plywood; 2009 (Revised 2019).
BB. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
   2. Furnish well casing and coordinate delivery with related excavation work.
   3. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
   4. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.
B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
   2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.
C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
   1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car guide rails, buffers, jack unit and other components.
   3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
   4. Clearances and over-travel of car.
   5. Locations in hoistwayand machine room of traveling cables and connections for car lighting and telephone.
   6. Location and sizes of hoistway and car doors and frames.
   7. Electrical characteristics and connection requirements.
   8. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
D. Samples: Submit samples illustrating car interior finishes, car and hoistway door and frame finishes, and handrail material and finish in the form of cut sheets or finish color selection brochures.
E. Testing Agency's Qualification Statement.
F. nspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Cache County School District 's name and registered with manufacturer.
H. Initial Maintenance Contract.
   1. Initial Maintenance Service: Beginning at Substantial Completion, provide one year’s full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
      a. Perform maintenance, including emergency callback service, during normal working hours.
      b. Include 24-hour-per-day, 7-day-per-week emergency callback service.
         1) Response Time: Two hours or less.
I. Maintenance Contract: Submit proposal to Owner for standard one year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
   1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
J. Operation and Maintenance Data:
   1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
   2. Operation and maintenance manual.

3. Schematic drawings of equipment and hydraulic piping, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.07 QUALITY ASSURANCE

A. Maintain one copy of each quality standard document on site.
B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten years documented experience.
D. Installer Qualifications: Trained personnel and supervisor on staff of elevator equipment manufacturer.
E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.
F. Products Requiring Fire Resistance Rating: Listed and classified by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.
B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design-Product: OTIS Gen-3 Edge. www.otis.com.
B. Other Acceptable Manufacturers:
   1. KONE Inc.
   2. Thyssenkrupp
   3. Schindler Elevator Corp.
C. Elevator company to provide pit ladder.
D. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Steel Cylinder Casing: ASTM A139/A139M, Grade A steel.
B. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.
C. Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel), with matte finish.
D. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
E. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
F. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

G. Extruded Brass Shapes: ASTM B455, Copper Alloy UNS C38500, Architectural Bronze, 57 percent copper, polished finish.
H. Seamless Brass Tubes: ASTM B135, Copper Alloy UNS C22000, Commercial Bronze, 90 percent copper, polished finish.
I. Brass Sheet: ASTM B36/B36M, Copper Alloy UNS C38500, Architectural Bronze, 57 percent copper.
J. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.
K. Nickel Silver Extrusions: ASTM B151 / B151M, Alloy UNS No. C74500 or No. C77600.
L. Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper.
M. Plywood: PS 1, Structural I, Grade C-D or better, sanded.
N. Carpet Flooring: As specified in Section 09 6800.
O. Stainless Steel Panels: No. 4 brushed finish and/or Plastic Laminate: NEMA LD 3, Type HGS, color as selected by Architect from manufacturer's standard line of colors.

2.03 SYSTEM DESCRIPTION

A. Elevator Qty. 1.
    1. Elevator Model: Gen-3 Edge.
    2. Elevator Type: Hydraulic passenger machine room-less.
    3. Rated Capacity: 2,100 lbs.
    4. Rated Speed: 150 ft./min.
    5. Operation System: TAC32H.
    6. Travel: 16'3".
    7. Landings: 3 total.
    8. Openings:
        a. Front: 2.
        b. Rear: 2.
    9. Clear Car Inside: 6'-5 9/16" wide by 5'-6 1/8".
    10. Inside clear height: 7'-4" standard.
    11. Door clear height: 7'-0" standard.
    12. Hoistway Entrance Size: 3'-0" wide by 7'-0" high.
    13. Door Type: One-speed LH Side opening.
    14. Power Characteristics: 480 volts, 3 Phase, 60 Hz.
    15. Seismic Requirements: Zone 3+.
    16. Hoistway Dimensions: 9'-1" clear hoist wall and pit.
    17. Pit Depth: 4'-0".
    18. Button and Fixture Style: Vandal-resistant signal fixtures.
    19. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

2.04 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
B. Accessibility Requirements: Comply with ADA Standards.
C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
E. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.
F. Perform electrical work in accordance with NFPA 70.

2.05 MATERIALS, GENERAL

A. Flooring by others.
B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.
C. Steel:
    1. Shapes and Bars: Carbon.
    2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
    3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.
D. Plastic Laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacturer’s standard selections.
E. Flooring by others.

2.06 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25 percent of the rated capacity.
B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
D. Guides: Slide guides shall be mounted on top and bottom of the car.
E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 2-stage. Two jacks piped together, mounted one on each side of the car with each having two telescopic sections designed to extend in a synchronized manner when oil is pumped into the Assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section.
G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade inherently biodegradable oil as specified by the manufacturer of the power unit (see Power Unit section 2.04.G for further details).

2.07 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:
   1. An oil reservoir with tank cover.
   2. An oil hydraulic pump.
   3. An electric motor.
   4. An oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
   1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
   2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
   3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
   4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
   5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
   6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
   7. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.08 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevator:
   1. Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
   2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
   1. Card-Reader Operation: System uses card readers at hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Provide stripe-swipe card reader integral with each car control station.
      a. Security access system equipment is specified in Division 28 Section "Electronic Access Control."
      b. Security access system equipment is not in the Contract.
   2. Elevator needs to include wiring and controller provisions at or near the hall stations to interface with a card reader system.

2.09 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
B. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
C. Emergency Power Operation: (10-DOA) Upon loss of the normal power supply, building-supplied standby power is available on the same wires as the normal power supply. Once the loss of normal power is detected and standby power is available, the elevator is lowered to a pre-designated landing and the doors are opened. After passengers have exited the elevator, the doors are closed and the car is shut down. When normal power is restored, the elevator automatically resumes operation.

2.10 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:
   1. Walls: Cab type TKAP, reinforced cold-rolled steel with two coats factory applied baked enamel finish.
      a. Premium Cab Options:
         1) Steel Shell Cab with raised laminate wall panels.
         2) Laminate to be selected from manufacturer’s catalog of choices.
   2. Reveals and Frieze: Stainless steel, no. 4 brushed finish.
   3. Canopy: Cold-rolled steel with hinged exit.
   4. Ceiling: Suspended type, LED lighting with translucent diffuser mounted in a metal frame. Framework shall be finished with a factory applied powder coat finish.
   5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with brushed stainless steel
   6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
      a. Door Finish: Stainless steel panels: No. 4 brushed finish.
      b. Cab Sills: Extruded aluminum, mill finish.
   7. Handrail: Provide 1.5' diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, no. 4 brushed finish.
   8. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.

9. Protection pads and buttons: Not required

2.11 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.
   1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
   1. Stainless-Steel Frames: Satin stainless steel, no. 4 finish.
   2. Stainless-Steel Doors: Satin stainless steel, no. 4 finish.
   3. Sight Guards: Provide sight guards on doors matching door edges.
   4. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
   5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.12 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.

B. Hall Stations, General: Vandal resistant buttons with center jewels which illuminate to indicate that a call has been registered at that floor for the indicated direction. Each button shall be provided with an internal automatic stop to prevent damage of switches that register the call. Provide 1 set of pushbutton risers.
   1. All fixtures shall be vandal resistant type.

C. Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
   1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
   2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."

F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
   1. Include travel direction arrows if not provided in car control station.

G. Hall Push-Button Stations: Provide one hall push-button station at each landing.

H. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.
   1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.
B. Verify that hoistway, pit, and machine room are ready for work of this section.
C. Verify hoistway shaft and openings are of correct size and within tolerance.
D. Verify location and size of machine foundation and position of machine foundation bolts.
E. Verify that electrical power is available and of correct characteristics.

3.02 PREPARATION

A. Arrange for temporary electrical power for installation work and testing of elevator components, and comply with requirements of Section 01 5000 - Temporary Facilities and Controls.

3.03 INSTALLATION

A. Coordinate this work with installation of hoistway wall construction.
B. Install system components, and connect equipment to building utilities.
C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26 0533.13 and 26 0583.
D. Install hydraulic piping between cylinder and pump unit.
E. Mount machines, motors, and pumps on vibration and acoustic isolators.
   1. Place on structural supports and bearing plates.
   2. Securely fasten to building supports.
   3. Prevent lateral displacement.
F. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
G. Install guide rails to allow for thermal expansion and contraction movement of guide rails.
H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
I. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
J. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
K. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
L. Adjust equipment for smooth and quiet operation.

3.04 ERECTION TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4300 - Quality Assurance, for additional requirements.

B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI 1 will be performed at their discretion.
   1. Schedule tests with agencies and notify Owner and Architect.
   2. Obtain permits as required to perform tests.
   3. Document regulatory agency tests and inspections in accordance with requirements.
   4. Perform tests required by regulatory agencies.
   5. Furnish test and approval certificates issued by authorities having jurisdiction.

C. Perform testing and inspection in accordance with requirements.
   1. Inspectors shall be certified in accordance with ASME QEI-1.
   2. Perform tests as required by ASME A17.2.
   3. Provide at least two weeks written notice of date and time of tests and inspections.
   4. Supply instruments and execute specific tests.

3.06 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.07 CLEANING

A. Remove protective coverings from finished surfaces.
B. Clean surfaces and components in accordance with manufacturers written instructions.

3.08 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
B. See Section 01 7900 - Demonstration and Training, for additional requirements.
C. Demonstrate proper operation of equipment to Owner's designated representative.
D. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, cleaning and maintenance of each component.
E. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.

3.09 PROTECTION

A. Do not permit construction traffic within car after cleaning.
B. Protect installed products until Date of Substantial Completion.
C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

3.10 MAINTENANCE

A. Refer to Section 01 7700 - Closeout Procedures, for additional requirements relating to initial maintenance service.
B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for 12 months from Date of Substantial Completion.
C. Submit proposal for continuation of Maintenance Contract in accordance with ASME A17.1 and requirements as indicated for installed elevator equipment.
D. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.

E. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
F. Examine system components bi-monthly.
G. Include systematic examination, adjustment, and lubrication of elevator equipment.
H. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
I. Perform work without removing cars from use during peak traffic periods.
J. Provide emergency call back service during regular working hours throughout period of this maintenance contract.
K. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION 14 2400

SECTION 21 1000

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:

1. Wet-pipe sprinkler systems.

B. Related Sections include the following:

1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
2. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
3. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

C. All black steel sprinkler pipe shall have a wall thickness less than or equal to schedule 40 and greater than schedule 10.

1. Exception: Pipe with a nominal pipe size of 6 inches and greater may be schedule 10.

D. Summary Table:

Item	Summary
Underground service entrance piping	Ductile Iron, restrained as required, with thrust blocks, transitioned with bolted flange.
Interior pipe type	Mains: Schedule 40 Branchlines: Threadable thinwall or schedule 40
Sprinkler Finish	Flat Plate Concealed, except uprights and storage
Extended Coverage	Not Allowed
Center of Tile	Required, Center thirds are acceptable for rectangular tiles
Flexible Sprinkler Drops	Designers preference
Calculations	Required, use reduced flow data
Alarm Device	Horn/Strobe
FDC	Flush Polished Brass 2-inlet Caps: Knox required purchased by contractor, coordinate installation with local Fire Department

1.3 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.

D. PE: Polyethylene plastic.

E. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Design sprinkler piping according to the following and obtain approval from engineer, prior to submitting to other authorities having jurisdiction:

1. Design sprinkler system with the following 10% reduced flow data:

   Flow data available at ---- .

   Static – ##psi

   Residual – ##psi @ ####gpm flowing

   Date of Test – ##/##/#### by ----.

2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

3. Sprinkler Occupancy Hazard Classifications:

   a. Building Service Areas: Ordinary Hazard, Group 1.
   b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   c. General Storage Areas: Ordinary Hazard, Group 1.
   d. Libraries, Except Stack Areas: Light Hazard.
   e. Library Stack Areas: Ordinary Hazard, Group 2.
   f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   g. Office and Public Areas: Light Hazard.

4. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
d. Special Occupancy Hazard: As determined by authorities having jurisdiction.

5. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft.
b. Storage Areas: 130 sq. ft.
c. Mechanical Equipment Rooms: 130 sq. ft.
d. Electrical Equipment Rooms: 130 sq. ft.
e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

7. Sprinklers are to be installed throughout the premises, as required by NFPA 13.

C. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13

1.6 SUBMITTALS

A. Product Data: For the following:
1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
2. Pipe hangers and supports, including seismic restraints.
3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
4. Air compressors, including electrical data.
5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
6. Hose connections, including size, type, and finish.
7. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
8. Alarm devices, including electrical data.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Fire-hydrant flow test report.

D. Seismic Calculations.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable. Drawings are to be approved by Engineer prior to submission to State Fire Marshal.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's

Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

G. Welding certificates.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor, who cannot show such experience, may be found not suitable to perform the work. The following are the approved contractors for this project:

a. PRE-APPROVED CONTRACTORS LIST
   1) Alta Fire
   2) Certified Fire
   3) Chaparral Fire
   4) Delta Fire
   5) Kimco Fire
   6) Paradise Fire
   7) Preferred Fire Protection
   8) Quality Fire Protection
   9) Fire Services Inc.
   10) FireTrol
   11) FireFly Fire Protection
   12) Simplex-Grinnell
   13) State Fire DC Specialties
   14) The Safety Team
   15) Western Automatic
   16) Or prior approved equal

b. A contractor not listed in the “PRE-APPROVED CONTRACTORS LIST” must receive prior approval from the engineer to bid this project.

B. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level III technician.

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

E. International Conference of Building Code Officials codes and standards complying with the following:

1. IBC-2018, “International Building Code.”
2. IFC-2018, “International Fire Code.”

F. Utah Amendments
1. Title 15A

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

1.10 General Engineering Quality

A. Unless noted otherwise the following applies:
1. The maximum water velocity shall not exceed 32-fps.
2. Submit the calculations using the reduced flow data.
3. When calculating flexible drops, the contractor shall use the maximum number of bends for the associated length. The value is to be taken from the UL tests (unless the material is only FM approved).
4. In the event of multiple (3) submittal rejections (including revise and resubmit) a meeting shall be held at the engineer’s office at the engineer time of choosing and the designer, fire sprinkler contractor, and general contractor shall be physically in attendance to discuss the required modifications to the design.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, Class 53, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

2.3 C-900 TUBE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket and spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.

2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Gaskets: AWWA C111, rubber.

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 STAINLESS STEEL IN BUILDING RISER

A. Continuous from the factory, no field formed fittings in the stainless steel riser. Field modifications are not allowed. Restrain with thrust block, per NFPA 24, rods as required by manufacture.

1. Inlet: AWWA C900/DIP
2. Outlet: AWWA 606

2.5 STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.

C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Manufacturers:

1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Victaulic Co. of America.
4) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe.
5. Steel Threaded Couplings: ASTM A 865.

F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.

1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.

G. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

H. Grooved-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Piping Systems:

a. Manufacturers:

1) Anvil International, Inc.
2) Central Sprinkler Corp.
3) Victaulic Co. of America.
4) Ward Manufacturing.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 is not allowed.

J. Plain-End, Nonstandard OD, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 10 is not allowed.

K. Plain-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5 is not allowed.

L. Grooved-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5; with factory- or field-formed, roll-grooved ends are not allowed.

M. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with plain ends is not allowed.

2.6 CPVC TUBE AND FITTINGS

1. Not permitted on this project.

2.7 FLEXIBLE SPRINKLER DROPS

A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 1: Threaded.

B. Manufacturers:

1. Flex-Head
2. Victaulic

C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.8 FLEXIBLE PIPE CONNECTORS (SEISMIC)

A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:

1. NPS 2 and Smaller: Threaded.
2. NPS 2-1/2 and Larger: Flanged.
3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.

B. Manufacturers:

1. Flexicraft Industries.
2. Flex-Pression, Ltd.
3. Metraflex, Inc.

C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.

D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.9 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.10 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be FMG approved with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-

psig minimum working-pressure rating if fittings are components of high-pressure piping systems.

B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body, with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

1. Manufactures:

a. Central Sprinkler Corp.
b. Fire-End and Croker Corp.
c. Viking Corp.
d. Victaulic Co. of America.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

2.11 LISTED FIRE-PROTECTION VALVES

A. Valves shall be FMG approved, with 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
3. Manufacturers:

a. Grinnell Fire Protection.
b. McWane, Inc.; Kennedy Valve Div.
c. NIBCO.
d. Stockham.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.

1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3: Ductile-iron body with grooved ends.
4. Manufacturers:

a. NIBCO.
b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.

1. NPS 2 and Smaller: Bronze body with threaded ends.

a. Manufacturers:

1) Global Safety Products, Inc.
2) Milwaukee Valve Company.

2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

1) Central Sprinkler Corp.
2) McWane, Inc.; Kennedy Valve Div.
3) Mueller Company.
4) NIBCO.
5) Victaulic Co. of America.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.

1. Manufacturers:

a. American Cast Iron Pipe Co.; Waterous Co.
b. Central Sprinkler Corp.
c. Clow Valve Co.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Fivalco
g. Globe Fire Sprinkler Corporation.
h. Grinnell Fire Protection.
i. Hammond Valve.
j. McWane, Inc.; Kennedy Valve Div.
k. Mueller Company.
l. NIBCO.
m. Potter-Roemer; Fire Protection Div.
n. Reliable Automatic Sprinkler Co., Inc.
o. Star Sprinkler Inc.
p. Stockham.
q. United Brass Works, Inc.
r. Victaulic Co. of America.
s. Watts Industries, Inc.; Water Products Div.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

a. Manufacturers:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Fivalco.
3) Hammond Valve.
4) NIBCO.
5) United Brass Works, Inc.

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

a. Manufacturers:

1) Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Fivalco
5) Hammond Valve.
6) Milwaukee Valve Company.
7) Mueller Company.
8) NIBCO.
9) United Brass Works, Inc.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and Visual.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Manufacturers:

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

1) Central Sprinkler Corp.
2) Grinnell Fire Protection.
3) McWane, Inc.; Kennedy Valve Div.
4) Milwaukee Valve Company.
5) NIBCO.
6) Victaulic Co. of America.

H. Supervised Normally Closed Valve

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and visual to send signal on partial close.

a. Manufactures:

1) NIBCO.
2) Victaulic Co. of America.

2.12 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.13 SPECIALTY VALVES

A. Sprinkler System Control Valves: FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating. Control valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

1. Manufacturers:

a. Globe Fire Sprinkler Corporation.
b. Reliable Automatic Sprinkler Co., Inc.
c. Victaulic Co. of America.
d. Viking Corp.

B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

1. Manufacturers:

a. Grinnell Fire Protection.

2.14 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Manufacturers:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Victaulic Co. of America.
4. Viking Corp.
5. Tyco Fire

C. Automatic Sprinklers: With heat-responsive element complying with the following:

1. UL 199, for nonresidential applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers, not allowed unless approved in writing prior to bidding.
3. Flow-control sprinklers, with automatic open and shutoff feature.
4. Flush ceiling sprinklers, including escutcheon, not allowed.
5. Institution sprinklers, made with a small, breakaway projection.
6. Pendent sprinklers.
7. Pendent, dry-type sprinklers.

8. Quick-response sprinklers.
9. Recessed sprinklers, including escutcheon.
10. Sidewall sprinklers.
11. Sidewall, dry-type sprinklers.
12. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Flat plate concealed, white.
2. Sidewall Mounting: Semi-Recessed, white.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.15 HOSE CONNECTIONS

A. Manufacturers:

1. Central Sprinkler Corp.
2. Elkhart Brass Mfg. Co., Inc.
3. Fire-End and Croker Corp.
4. Fivalco
5. Grinnell Fire Protection.
6. Guardian Fire Equipment Incorporated.
7. McWane, Inc.; Kennedy Valve Div.
8. Mueller Company.
9. Potter-Roemer; Fire-Protection Div.
10. United Brass Works, Inc.

B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Finish: Rough metal.

2.16 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. Central Sprinkler Corp.
2. Elkhart Brass Mfg. Co., Inc.
3. Fire-End and Croker Corp.
4. Fire Protection Products, Inc.
5. Guardian Fire Equipment Incorporated.
6. Potter-Roemer; Fire-Protection Div.
7. Reliable Automatic Sprinkler Co., Inc.

8. United Brass Works, Inc.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR."

1. Type: Flush, with two inlets and square or rectangular escutcheon plate.
2. Finish: Polished brass.

2.17 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm: UL 464, with 8-inch- minimum- diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

1. Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.

C. Electrically Operated Alarm: Horn/Strobe, NEMA 3R minimum suitable for outdoor use.

1. Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.

D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers:

a. ADT Security Services, Inc.
b. Grinnell Fire Protection.
c. ITT McDonnell & Miller.
d. Potter Electric Signal Company.
e. System Sensor.
f. Viking Corp.
g. Watts Industries, Inc.; Water Products Div.

E. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

1. Manufacturers:

a. Grinnell Fire Protection.

b. Potter Electric Signal Company.
c. System Sensor.
d. Viking Corp.

F. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:

a. McWane, Inc.; Kennedy Valve Div.
b. Potter Electric Signal Company.
c. System Sensor.

G. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

1. Manufacturers:

a. Potter Electric Signal Company.
b. System Sensor.

2.18 PRESSURE GAGES

A. Manufacturers:

1. Brecco Corporation.
2. Dresser Equipment Group; Instrument Div.
3. Marsh Bellofram.
4. WIKA Instrument Corporation.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.

1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

2.19 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers

1. Ames
2. Backflow Direct
3. Febco
4. Wilkins
5. Watts

B. Description; Resilient seated, spring loaded with testable outlets provided, as required by Authorities Having Jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Obtain Engineer's Water Analysis or fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.

B. Engineer's Water Analysis. See Flow Analysis provided by Van Boerum & Frank Associates.

3.2 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

E. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

F. Sprinkler Main Piping: Use the following:

1. NPS 6 and Smaller: Standard-weight steel pipe with threaded ends, or grooved ends. No plain ends allowed.
2. Outlets shall be welded.

    a. Victaulic Brand Mechanical tee fittings may be used in lieu of welded outlets.

G. Branch line piping: Use the following:

1. NPS 2 and Smaller: Threadable steel pipe with threaded ends**, or roll-grooved ends.**

   a. Victaulic made-on sprinkler flex drops, and grooved weld-o-lets may be used.
   b. Victaulic Brand Mechanical tee fittings may be used

3.5 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

   1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13 and NFPA 14.
   2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13 and NFPA 14.

      a. Shutoff Duty: Use gate, ball, or butterfly valves.
      b. Throttling Duty: Use globe, ball, or butterfly valves.

3.6 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping joint construction.

B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.7 WATER-SUPPLY CONNECTION

A. Install shutoff Backflow preventions assemblies, valve, pressure gage’s, drain, and other accessories at connection to water service.

3.8 PIPING INSTALLATION

A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground service-entrance piping according to NFPA 24 and with restrained joints.

D. Install all new underground service-entrance piping with restrained joints, hydrants, and post indicator valves per FM Global Data Sheet 3-10.

E. Make connections between underground and above-ground piping using bolted flange.

F. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls. Refer to Division 23 Section “Common Work Result for HVAC.”

G. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

H. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

I. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

J. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

K. Install sprinkler piping with drains for complete system drainage.

L. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

M. Install alarm devices in piping systems.

N. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. No powder driven studs allowed.
2. Wrap-around braces are to be provided at end of branch lines.

O. Earthquake Protection: Install piping according to NFPA 13-9.3 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.

P. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.

Q. Install pressure gages on riser or feed main, at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

R. When a fire pipe crosses a seismic expansion joint it shall have a Metraflex fire loop installed at the joint in accordance with NFPA 13 chapter 9.

3.9 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.10 VALVE INSTALLATION

A. Refer to Division 23 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.

B. Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

C. Double Check Valve Assemblies: Install valves in vertical up or horizontal position, per listings and for proper direction of flow.

3.11 SPRINKLER APPLICATIONS

A. General: All sprinklers are to be quick response type. Sprinkler heads shall be of the latest design closed spray type for 155°F unless specified otherwise or required by code. Extended coverage heads shall not be used. Orifices larger than 1/2" may be used as required by density and spacing demands. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7’-0” height above the floor or where damage from room occupant use may occur.
2. Rooms with Ceilings: Concealed sprinklers, where indicated.
3. Wall Mounting: Sidewall sprinklers with recessed escutcheon.
4. Institutional sprinklers shall be installed in areas of detention, correctional or mental health care facilities.
5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
6. Provide freeze proof type automatic sprinkler heads serving unconditioned spaces, areas subject to freezing and in other areas requiring their use.
7. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
8. Sprinkler Finishes: Use sprinklers with the following finishes:

   a. Upright, Pendent, and Sidewall Sprinklers: Chrome in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.
   b. Concealed Sprinklers: Rough brass, with White cover plate to match ceiling color.

B. Sprinklers: Use the following:

1. All sprinklers shall be listed, quick response type.
2. Sprinkler in future finish spaces (shelled) 10’ x 10’ spacing shall be pendents/uprights installed with 1 x ½" bushing, to accommodate future finishes.

3.12 SPRINKLER INSTALLATION

A. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads should be symmetrical and all piping run parallel or perpendicular to building lines.

1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions and HVAC ductwork.
2. Sprinkler heads shall not conflict with tile grids.
3. Sprinkler heads shall be located near center of corridors.

B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect or such locations shown do not meet the requirements of NFPA-13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. If the installation of additional heads is needed to conform to NFPA 13 requirements in areas where heads are shown on reflected ceiling plans, they shall be included in the contract price.

C. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

D. Future finish shelled and tenant finish; Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x ½" bushings, and space heads at a maximum spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.

E. Concealed type sprinkler shall be installed in the following areas:

1. Throughout

3.13 FIRE DEPARTMENT CONNECTION INSTALLATION

A. When installing the Fire Department Connection, the contractor is to ensure that there are no permanent obstruction(s) as to the fire department access. If an obstruction is present immediately notify the designer and the design team before proceeding with the installation.

B. Coordinate the exact location with the Architect and the Authority Having Jurisdiction.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

3.14 CONNECTIONS

A. Connect water-supply piping and sprinklers where indicated.

B. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

C. Electrical Connections: Power wiring is specified in Division 28.

D. Connect alarm devices to fire alarm.

3.15 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 23 Section "Common Work Result for HVAC."

3.16 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.

B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

C. When making a mechanical tee connection the coupon shall be attached at the mechanical tee.

D. Report test results promptly and in writing to Architect and authorities having jurisdiction.

E. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and tested by the contractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.17 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

3.18 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.19 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete and that “Material Test Certificates” are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.

F. Fill wet-pipe sprinkler piping with water.

G. Verify that hose connections are correct type and size.

H. Coordinate with fire alarm tests. Operate as required.

3.20 DEMONSTRATION & TESTS

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi in excess of the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.

C. The local jurisdiction having authority and the Utah State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.

D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead, backflow and underground work are completed and delivered to the owner’s insurance underwriter to assure proper insurance credit.

E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

3.21 WARRANTY

A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.

B. Provide Operation and Maintenance Manuals with correct as-builts test certificates and warranties included. A minimum 6 sets to be provided in red 3-ring binders. Include a current adopted version of NFPA 25 softbound copy left with owner.

C. Electronic copy of AutoCAD as-built drawings shall also be provided on CD, with each O&M Manual.

3.22 FIELD QUALITY CONTROL

A. Flush, test and inspect sprinkler piping according to NFPA 13, “System Acceptance” Chapter.

B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 21 1000

SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.
12. Link Seal

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Fernco, Inc.
    c. Mission Rubber Company.
    d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.

d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.10 LINK SEAL

A. Link-Seal® Modular Seal Pressure Plates

1. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:

   a. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
   Flexural Strength @ Yield = 30,750 psi per ASTM D-790
   Flexural Modulus = 1,124,000 psi per ASTM D-790
   Elongation Break = 11.07% per ASTM D-638
   Specific Gravity = 1.38 per ASTM D-792

2. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a “Hex Nut Interlock” designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer’s name molded into it.
3. For fire and Hi-Temp service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
4. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be: 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 SEISMIC REQUIREMENTS

A. Comply with SEI/ASCE 7 and with requirements for seismic seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
g. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
h. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

J. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.7 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.11 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500

SECTION 220513

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to **600 V** and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when the requirements in plumbing equipment schedules, other specification sections, drawing notes or in other contract documents are more stringent.

B. Comply with **NEMA MG 1** unless otherwise indicated.

C. Comply with **IEEE 841** for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of and at altitude of **3300 feet** above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: **NEMA MG 1**, **Design B**, medium induction motor.

B. Efficiency: Energy efficient, as defined in **NEMA MG 1**.

C. Service Factor: **1.15**.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.

G. Insulation: **Class F**. Code Letter Designation:

1. Motors **15 HP** and Larger: NEMA starting Code F or Code G.
2. Motors smaller than **15 HP**: Manufacturer's standard starting characteristic.

H. Enclosure Material: Cast iron for motor frame sizes **324T** and larger; rolled steel for motor frame sizes smaller than **324T**.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than **1/20** hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors **1/20 HP** and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor

insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

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SECTION 220517

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.

2. CALPICO, Inc.
3. Link-Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: **EPDM-rubber** interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: **Carbon steel**
3. Connecting Bolts and Nuts: **Carbon steel, with corrosion-resistant coating**, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: **5000-psi, 28-day** compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide **1-inch** annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves**.
   b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves**.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves with sleeve-seal system**.

      1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves with sleeve-seal system**.

      1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

   a. Piping Smaller Than **NPS 6**: **Cast-iron wall sleeves with sleeve-seal system**.

      1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping **NPS 6** and Larger: **Cast-iron wall sleeves with sleeve-seal system**.

1) Select sleeve size to allow for **1-inch** annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than **NPS 6**: **Galvanized-steel-pipe.**
b. Piping **NPS 6** and Larger: **Galvanized-steel-pipe.**

5. Interior Partitions:

a. Piping Smaller Than **NPS 6**: **Galvanized-steel-pipe sleeves**.
b. Piping **NPS 6** and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220519

METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.

13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.
15. Weksler

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 5 inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass or plastic.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

    a. Flo Fab Inc.
    b. Miljoco Corporation.
    c. Palmer Wahl Instrumentation Group.
    d. Tel-Tru Manufacturing Company.
    e. Trerice, H. O. Co.
    f. Weiss Instruments, Inc.
    g. Winters Instruments - U.S.
    h. Weksler

2. Standard: ASME B40.200.
3. Case: Cast aluminum 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. Flo Fab Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
    m. Weiss Instruments, Inc.
    n. WIKA Instrument Corporation - USA.
    o. Winters Instruments - U.S.
    p. Weksler

2. Standard: ASME B40.100.
3. Case: Liquid-filled Open-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal or Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACH TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Weksler.
8. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for water service at 20 to 200 deg F shall be CR.
2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer, and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. Carrying case shall have formed instrument padding.

2.6 ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid one-third of pipe diameter to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gage for fluids.

H. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each domestic water heat exchanger.
3. Inlet and outlet of each domestic hot-water storage tank.
4. Inlet and outlet of each remote domestic water chiller.

I. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

J. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

K. Adjust faces of meters and gages to proper angle for best visibility.

L. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinds. Use minimum tubing length.

M. Install test plugs in tees in piping.

N. Install permanent indicator on walls or brackets in accessible and readable positions.

3.2 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:

1. Liquid-filled Sealed, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:

1. Liquid-filled Sealed, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:

1. Liquid-filled Sealed, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

D. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F and minus 20 to plus 70 deg C.

B. Scale Range for Domestic Hot-Water Piping**:** 20 to 240 deg F and 0 to 150 deg C.

3.4 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Liquid-filled Sealed Open-front, pressure-relief, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:

1. Liquid-filled Sealed Open-front, pressure-relief, direct mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Liquid-filled Sealed Open-front, pressure-relief , direct-mounted, metal case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping 0 to 160 psi and 0 to 1100 kPa.

B. Scale Range for Domestic Water Piping: 0 to 160 psi and 0 to 1100 kPa.

END OF SECTION 220519

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Bronze globe valves.
8. Iron globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Lance Valves; a division of Advanced Thermal Systems, Inc.

f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.

f. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Division.
f. DeZurik Water Controls.
g. Flo Fab Inc.
h. Hammond Valve.

i. Kitz Corporation.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Norriseal; a Dover Corporation company.
m. Red-White Valve Corporation.
n. Spence Strainers International; a division of CIRCOR International, Inc.
o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Milwaukee Valve Company.
l. Mueller Steam Specialty; a division of SPX Corporation.
m. NIBCO INC.
n. Norriseal; a Dover Corporation company.
o. Spence Strainers International; a division of CIRCOR International, Inc.
p. Sure Flow Equipment Inc.
q. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated or -coated ductile iron.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. American Valve, Inc.
    c. Conbraco Industries, Inc.; Apollo Valves.
    d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
    e. Crane Co.; Crane Valve Group; Jenkins Valves.
    f. Crane Co.; Crane Valve Group; Stockham Division.
    g. DeZurik Water Controls.
    h. Flo Fab Inc.
    i. Hammond Valve.
    j. Kitz Corporation.
    k. Milwaukee Valve Company.
    l. Mueller Steam Specialty; a division of SPX Corporation.
    m. NIBCO INC.
    n. Norriseal; a Dover Corporation company.
    o. Red-White Valve Corporation.
    p. Spence Strainers International; a division of CIRCOR International, Inc.
    q. Sure Flow Equipment Inc.
    r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-67, Type I.
    b. CWP Rating: 200 psig.
    c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    e. Seat: EPDM.
    f. Stem: One- or two-piece stainless steel.
    g. Disc: Stainless steel.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 200 psig.
    c. Body Design: Vertical flow.
    d. Body Material: ASTM B 61 or ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

2.6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. Hammond Valve.
    f. Kitz Corporation.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Powell Valves.
    j. Red-White Valve Corporation.
    k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    l. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 200 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Valve, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. Kitz Corporation.
    f. Milwaukee Valve Company.
    g. NIBCO INC.
    h. Red-White Valve Corporation.
    i. Zy-Tech Global Industries, Inc.

2. Description:

    a. Standard: MSS SP-80, Type 3.
    b. CWP Rating: 300 psig.
    c. Body Design: Horizontal flow.
    d. Body Material: ASTM B 62, bronze.
    e. Ends: Threaded.
    f. Disc: Bronze.

2.7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Powell Valves.
   i. Red-White Valve Corporation.
   j. Sure Flow Equipment Inc.
   k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   l. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-71, Type I.
   b. CWP Rating: 500 psig.
   c. Body Design: Clear or full waterway.
   d. Body Material: ASTM A 126, gray iron with bolted bonnet.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Gasket: Asbestos free.

2.8 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Hammond Valve.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Powell Valves.
   h. Red-White Valve Corporation.
   i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   j. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded or solder joint.
   e. Stem and Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Division.
   d. Hammond Valve.
   e. Kitz Corporation.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Powell Valves.
   i. Red-White Valve Corporation.
   j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   k. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.

e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service Globe, angle, ball or butterfly valves.
4. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or check valves.
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.

3. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.
5. Bronze Globe Valves: Class 125 or Class 150, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze, ductile-iron or stainless-steel disc.
4. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
5. Iron Globe Valves: Class 125 or Class 250.

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SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SEISMIC REQUIREMENTS

A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor, I*p*, shall be taken as 1.5 if any of the following conditions apply:

1. The component is required to function for life-safety purposes after an earthquake.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

B. All other components shall be assigned a component importance factor, I*p*, equal to 1.0.

1.5 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 " Vibration and Seismic Controls for Plumbing Piping and Equipment.

1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."

2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.6 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.
5. Mechanical Anchors: ICC-ES Evaluation Reports validating ‘Cracked Concrete’ testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

D. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Project specific design documentation and calculations shall be prepared and stamped by a registered professional engineer who is responsible for the seismic restraint design and who is licensed in the state where the project is being constructed (ASCE 7, 13.2.1.1).

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. Anvil International.
2. AAA Technology & Specialties Co., Inc.
3. Bergen-Power Pipe Supports.
4. B-Line Systems, Inc.; a division of Cooper Industries.

5. Carpenter & Paterson, Inc.
6. Empire Industries, Inc.
7. ERICO/Michigan Hanger Co.
8. FNW/Ferguson Enterprises
9. Globe Pipe Hanger Products, Inc.
10. Grinnell Corp.
11. GS Metals Corp.
12. National Pipe Hanger Corporation.
13. PHD Manufacturing, Inc.
14. PHS Industries, Inc.
15. Piping Technology & Products, Inc.
16. Tolco Inc.
17. Simpson Strong-Tie Co.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Anvil International.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. FNW/Ferguson Enterprises
5. GS Metals Corp.
6. Hilti, Inc.
7. Power-Strut Div.; Tyco International, Ltd.
8. Thomas & Betts Corporation.
9. Tolco Inc.
10. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. Hilti, Inc.
b. MKT Fastening, LLC.
c. Powers Fasteners.
d. Simpson Strong-Tie Co.

B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for ‘Cracked Concrete’ per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: ‘*’

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.

e. MKT Fastening, LLC.
f. Powers Fasteners.
g. Simpson Strong-Tie Co. *

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:

a. Anvil International.
b. ERICO/Michigan Hanger Co.
c. MIRO Industries.
d. Unipure

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:

a. Anvil International.
b. ERICO/Michigan Hanger Co.
c. MIRO Industries.
d. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:

a. Anvil International.
b. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.

5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

C. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Powder actuated fasteners shall not be used for seismic bracing attachments.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for ‘Cracked Concrete’ per A.C. 193 and shall have a valid ICC-ES Evaluation Report

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete

is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports. For applications where seismic bracing is required, 'Cracked Concrete' expansion anchors or concrete screws tested

per A.C. 193 must be provided for seismic bracing anchorage where post-installed anchors are required.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

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SECTION 220533

HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:

1. Constant wattage.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 WARRANTY

A. When warranties are required, verify with Owner's counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 01 Section "Product Requirements."

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONSTANT-WATTAGE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BH Thermal Corporation.
2. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
3. Delta-Therm Corporation.
4. Easy Heat Inc.
5. Nelson Heat Trace.
6. Pyrotenax; a division of Tyco Thermal Controls.
7. Raychem; a division of Tyco Thermal Controls.
8. Thermon Manufacturing Co.
9. Trasor Corp.

B. Heating Element: Pair of parallel No. 12 AWG, nickel-coated stranded copper bus wires with single-stranded resistor wire connected between bus wires. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight.

C. Electrical Insulating Jacket: Flame-retardant fluoropolymer.

D. Cable Cover: Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.

E. Maximum Operating Temperature (Power On): 392 deg F.

F. Capacities and Characteristics:

1. Maximum Heat Output: Provide capacities and characteristics as noted on the drawings.

2.2 CONTROLS

A. Pipe-Mounting Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Division 22 Section "Identification for Plumbing Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Install the following types of electric heating cable for the applications described:

1. Snow and Ice Melting in Gutters and Downspouts: Constant-wattage heating cable.
2. Freeze protection for roof drainage piping: Constant-wattage.

3.3 INSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written recommendations using cable protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating Cable Installation for Snow and Ice Melting in Gutters and Downspouts: Install in gutters and downspouts with clips furnished by manufacturer that are compatible with gutters, and downspouts.

C. Electric Heating Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Division 22 Section "Plumbing Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

D. Set field-adjustable switches and circuit-breaker trip ranges.

E. Protect installed heating cables, including nonheating leads, from damage.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

1. Test cables for electrical continuity and insulation integrity before energizing.
2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 220533

SECTION 220548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following restraints and vibration isolation as defined in Section 230548 “Vibration Isolation and Seismic Controls for HVAC” for the following:

1. Plumbing Piping.
2. Plumbing Equipment.

PART 2 - PRODUCTS

2.1 (NOT USED)

PART 3 - EXECUTION

3.1 (NOT USED)

END OF SECTION 220548

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SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.
7. Ceiling grid

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

2.7 CEILING GRID

A. Provide valve identification for all plumbing and med gas valves located above the ceiling on the ceiling grid below the valve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feetalong each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:

   a. Background Color: Comply with ASME A13.1.
   b. Letter Color: Comply with ASME A13.1.

2. Medium-Pressure, Compressed-Air Piping:

   a. Background Color: Comply with ASME A13.1.
   b. Letter Color: Comply with ASME A13.1.

3. Domestic Water Piping:

   a. Background Color: Comply with ASME A13.1.
   b. Letter Color: Comply with ASME A13.1.

4. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Comply with ASME A13.1.
   b. Letter Color: Comply with ASME A13.1.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.
   c. Low-Pressure Compressed Air: 1-1/2 inches, round.
   d. High-Pressure Compressed Air: 1-1/2 inches, round.

2. Valve-Tag Color:

   a. Cold Water: Comply with ASME A13.1.
   b. Hot Water: Comply with ASME A13.1.
   c. Low-Pressure Compressed Air: Comply with ASME A13.1.
   d. High-Pressure Compressed Air: Comply with ASME A13.1.

3. Letter Color:

    a. Cold Water: Comply with ASME A13.1.
    b. Hot Water: Comply with ASME A13.1.
    c. Low-Pressure Compressed Air: Comply with ASME A13.1.
    d. High-Pressure Compressed Air: Comply with ASME A13.1.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719

PLUMBING PIPING INSULATION.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Storm-water piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 DEFINITIONS:

A. Refer to Section 220500 “Common Work Results for Plumbing”.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Insulation for below-ambient service requires a vapor-barrier.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553:

1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000-Degree Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A,
   a. **Without factory-applied jacket** with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide the following:

   a. Ramco Insulation, Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following:

   a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 739, Dow Silicone.
   b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F .
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F .
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F .
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F .
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. **ASJ Flashing Sealants,** and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F .
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.

   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: Color-code jackets based on system**.**
      a. White.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
      b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      c. RPR Products, Inc.; Insul-Mate.

   2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper. [**3-mil- thick, heat-bonded polyethylene and kraft paper**] [**2.5-mil- thick polysurlyn**].
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper. [**2.5-mil- thick polysurlyn**].
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. ABI, Ideal Tape Division; 488 AWF.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    c. Compac Corporation; 120.
    d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

    a. Engineered Brass Company.
    b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    c. McGuire Manufacturing.
    d. Plumberex.
    e. Truebro; a brand of IPS Corporation.
    f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

    a. Truebro; a brand of IPS Corporation.
    b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
   a. **2 inches** o.c.
   b. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch , and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. **NPS 1-1/2** and Smaller: Insulation shall be one of the following;

   a. Flexible Elastomeric:
      1) **1 inch** thick
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      1) **1 inch** thick

2. **NPS 2** and Larger: Insulation shall be one of the following:

   a. Flexible Elastomeric:
      1) **1-1/2 inches** thick.
   b. Mineral-Fiber, Preformed Pipe Insulation:
      1) 1-1/2 inches thick.

B. Domestic Hot and Recirculated Hot Water:

1. **NPS 1-1/2** and Smaller: Insulation shall be **one of** the following:

   a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      1) 1 inch thick.

2. **NPS 2** and Larger: Insulation shall be **one of** the following:

   a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      1) 1-1/2 inches thick

C. Storm water and Overflow:

1. All Pipe Sizes: Insulation shall be **one of** the following:

   a. Flexible Elastomeric: **1 inch** thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be **one of** the following:

   a. Flexible Elastomeric: **1 inch** thick.
   b. Mineral-Fiber, Blanket Insulation, Type I: **1 inch** thick.
   c. Drain Manufacturer's Pre-formed bowl Insulation: **1 inch** thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Storm water and Overflow:

1. All Pipe Sizes: Insulation shall be **one of** the following:

   a. Flexible Elastomeric: **1 inch** thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: **1 inch** thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. **PVC**:
   a. White: 20 mils thick

D. Piping, Exposed:

1. PVC:
   a. White: **30 mils thick**

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. Aluminum, Stucco Embossed: 0.016 inch thick.

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SECTION 22 1116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

C. All piping shall be American made and tested; no import pipe will be permitted.

D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.

E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: **ASTM B 88, Type K** and **ASTM B 88, Type L** water tube, drawn temper.

B. Soft Copper Tube: **ASTM B 88, Type K** and **ASTM B 88, Type L** water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PP PIPE AND FITTINGS

A. PP Pipe: ASTM F 2389, **SDR 7.4 and SDR 11**.

B. PP Socket Fittings: ASTM F 2389.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. PP Pipe and Fittings: Manufacturer's recommended fusion-weld system.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.

e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description:

a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. PP-to-Metal Transition Fittings:

1. Description:

a. PP one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one fusion-socket end.

F. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Colonial Engineering, Inc.
b. NIBCO Inc.
c. Spears Manufacturing Company.

2. Description:

a. **CPVC** four-part union.
b. **Brass** threaded end.
c. **Solvent-cement-joint** plastic end.
d. Rubber O-ring.
e. Union nut.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive high temperature insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples and Waterways:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.

c. Matco-Norca.
d. Clearflow/Perfection Corp.
e. Precision Plumbing Products, Inc.
f. Victaulic Company.

2. Standard: IAPMO PS 66 or ASTM F-1545-97.
3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF-61 Compliant.
4. Pressure Rating and Temperature: **300 psig at 225 deg F.**
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene or LTHS.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.

C. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

D. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

E. Install underground **copper tube** in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Division 22 Section "Domestic Water Piping Specialties."

G. Install shutoff valve immediately upstream of each dielectric fitting.

H. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Division 22 Section "Domestic Water Piping Specialties."

I. Install domestic water piping level **without pitch** and plumb.

J. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

K. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

L. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

M. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

O. Install piping to permit valve servicing.

P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

T. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22 Section "Meters and Gages for Plumbing Piping."

U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."

V. Install thermometers on **inlet and outlet** piping from each water heater. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

H. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition **fittings**.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use **dielectric nipples/waterways**.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use **dielectric nipples/waterways**.

D. Dielectric Fittings for NPS 5 and Larger: Use **dielectric nipples/waterways**.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

J. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code. Comply with requirements for connection sizes in Division 22 plumbing fixture Sections.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Some piping types and sizes mentioned in this section may not be used on this project.

B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.

E. Under-building-slab, domestic water, building-service piping, NPS 3and smaller, shall be the following:

1. Soft copper tube, **ASTM B 88, Type K wrought-copper, solder-joint fittings**; and brazed joints.

F. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be the following:

1. Soft copper tube, **ASTM B 88, Type K**; wrought-copper, solder-joint fittings; and brazed joints.

G. Aboveground domestic water piping, **NPS 2 and smaller**, shall be one of the following:
1. Hard copper tube, **ASTM B 88, Type L**; **cast-**copper, solder-joint fittings; and **soldered** joints.

H. Aboveground domestic water piping, **NPS 2-1/2 to NPS 4**, shall be one of the following:

1. Hard copper tube, **ASTM B 88, Type L**; **cast- or wrought-** copper, solder-joint fittings; and **brazed** joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use **ball** for piping NPS 3 and smaller. Use **butterfly**, with flanged ends for piping NPS 4 and larger.
2. Throttling Duty: Use **ball** valves for piping NPS 2 and smaller. Use **butterfly** valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: **Calibrated** balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water hammer arresters.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
3. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Co.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. FEBCO; SPX Valves & Controls.
   e. Rain Bird Corporation.
   f. Toro Company (The); Irrigation Div.
   g. Watts Industries, Inc.; Water Products Div.
   h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. MIFAB, Inc.
   e. Prier Products, Inc.
   f. Watts Industries, Inc.; Water Products Div.

g. Woodford Manufacturing Company.
h. Zurn Plumbing Products Group; Light Commercial Operation.
i. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.

d. Flomatic Corporation.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved] for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ames Co.
b. Conbraco Industries, Inc.
c. FEBCO; SPX Valves & Controls.
d. Flomatic Corporation.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; [flanged] <Insert type> for NPS 2-1/2 and larger.
7. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Beverage-Dispensing-Equipment Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.

5. Body: Stainless steel.
6. End Connections: Threaded.

D. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Flomatic Corporation.
   e. Ford Meter Box Company, Inc. (The).
   f. Honeywell Water Controls.
   g. McDonald, A. Y. Mfg. Co.
   h. Mueller Co.; Water Products Div.
   i. Watts Industries, Inc.; Water Products Div.
   j. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

E. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cash Acme.
   b. Lancer Corporation.
   c. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1032.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators: (Direct Type)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.

4. Body: Bronze, provide chrome-plated finish if connected to chrome plated or stainless steel piping for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves: (Pilot type)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CLA-VAL Automatic Control Valves.
   b. Mifab Corp; Beeco.
   c. Watts Industries, Inc.; Ames Fluid Control Systems.
   d. Watts Industries, Inc.; Watts ACV.
   e. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Flo Fab Inc.
   c. ITT Industries; Bell & Gossett Div.
   d. NIBCO INC.
   e. TAC Americas.
   f. Taco, Inc.
   g. Victaulic
   h. Watts Industries, Inc.; Water Products Div.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Armstrong International, Inc.
   b. Flo Fab Inc.

c. ITT Industries; Bell & Gossett Div.
d. NIBCO INC.
e. TAC Americas.
f. Watts Industries, Inc.; Water Products Div.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Cash Acme.
c. Conbraco Industries, Inc.
d. Honeywell Water Controls.
e. Leonard Valve Company.
f. Powers; a Watts Industries Co.
g. Symmons Industries, Inc.
h. Taco, Inc.
i. Watts Industries, Inc.; Water Products Div.
j. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a Watts Industries Co.
e. Symmons Industries, Inc.

2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Valve Finish: Chrome plated.
10. Piping Finish: Copper.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company.
   f. Powers; a Watts Industries Co.
   g. Watts Industries, Inc.; Water Products Div.
   h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 OUTLET BOXES

A. Water Outlet Boxes ICE-1:

1. Basis of Design: Water-Tite model W9200HA 6” diameter outlet box with ¼ turn valve and water hammer arrestor.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Acorn Engineering Company.
    b. IPS Corporation.
    c. LSP Products Group, Inc.
    d. Oatey.
    e. Plastic Oddities; a division of Diverse Corporate Technologies.

3. Mounting: Recessed.
4. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
5. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
6. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.8 HOSE BIBBS

A. Hose Bibbs HB-1:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants FWH-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company.
    b. MIFAB, Inc.
    c. Prier Products, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Woodford Manufacturing Company.
    h. Zurn Plumbing Products Group; Light Commercial Operation.

i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Operating Keys: Two with each wall hydrant.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMTROL, Inc.
b. Josam Company.
c. MIFAB, Inc.
d. PPP Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
g. Tyler Pipe; Wade Div.
h. Watts Drainage Products Inc.
i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

H. Install water hammer arresters in water piping according to PDI-WH 201.

I. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

J. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

K. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.
3. Double-check backflow-prevention assemblies.
4. Carbonated-beverage-machine backflow preventers.
5. Dual-check-valve backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.
8. Primary, thermostatic, water mixing valves.
9. Primary water tempering valves.
10. Outlet boxes.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221123

DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:

1. Separately-coupled, horizontally mounted, in-line centrifugal pumps.

1.3 SEISMIC REQUIREMENTS

A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor, I*p*, shall be taken as 1.5 if any of the following conditions apply:

1. The component is required to function for life-safety purposes after an earthquake.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

B. All other components shall be assigned a component importance factor, I*p*, equal to 1.0.

C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 " Vibration and Seismic Controls for Plumbing Piping and Equipment.

1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."

2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SEPARATELY COUPLED, HORIZONTALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong.
2. Aurora Pump; Pentair Pump Group (The).
3. Bell & Gossett Domestic Pump; ITT Industries.
4. Grundfos Pumps Corp.
5. Taco, Inc.
6. Thrush Company, Inc.
7. Weinman Div.; Crane Pumps & Systems.

B. Description: Factory-assembled and -tested, overhung-impeller, single-stage, separately coupled, horizontally mounted, in-line centrifugal pumps as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.

1. Pump Construction: All bronze.

    a. Casing: Radially split, cast iron, with threaded companion-flange connections for pumps with NPS 2 pipe connections and flanged connections for pumps with NPS 2-1/2 pipe connections.
    b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, and keyed to shaft.
    c. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.
    d. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.
    e. Bearings: Oil-lubricated; bronze-journal or ball type.

2. Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
3. Motor: Single speed, with grease-lubricated ball bearings; and resiliently mounted to pump casing. Comply with requirements in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

2.3 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Anamet, Inc.
2. Flex-Hose Co., Inc.
3. Flexicraft Industries.
4. Flex-Pression, Ltd.
5. Flex-Weld, Inc.
6. Fugate
7. Hyspan Precision Products, Inc.
8. Mercer Rubber.
9. Metraflex, Inc.
10. Proco Products, Inc.
11. Tozen America Corporation.
12. Twin City Hose.
13. Unaflex Inc.

B. Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include 125-psig minimum working-pressure rating and ends matching pump connections.

2.4 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with HI 1.4.

C. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

E. Install separately coupled, horizontally mounted, in-line centrifugal pumps with motor and pump shafts horizontal.

F. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of sufficient size to support pump weight. Vibration isolation devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

a. Separately coupled, horizontally mounted, in-line centrifugal pumps.

2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and gage connectors.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

F. Interlock pump with water heater burner and time delay relay.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.
8. Adjust temperature settings on thermostats.
9. Adjust timer settings.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 221123

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SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: **10-foot head of water**.
2. Waste, Force-Main Piping: **50 psig**.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor's expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AB&I Foundry
    b. Charoltte Pipe
    c. Tyler Pipe

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ANACO.
    b. Ideal
    c. Mission Rubber Company; a division of MCP Industries, Inc.
    d. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Husky SD 4000.

b. Clamp-All Corp HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Grooved-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51 with round-cut-grooved ends according to AWWA C606.
2. Ductile-Iron-Pipe Appurtenances:

a. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:

1) Anvil International.
2) Shurjoint Piping Products.
3) Victaulic Company.

b. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings and complying with AWWA C606 for grooved ends.
c. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: **2 percent downward in direction of flow for piping for NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.**
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
4. **Grease Waste: 2 percent downward in direction of flow for piping.**

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install underground **PVC** piping according to ASTM D 2321.

P. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

Q. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
3. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install **carbon-s**teel pipe hangers for horizontal piping in noncorrosive environments.
2. Install **stainless-steel** pipe hangers for horizontal piping in corrosive environments.
3. Install **carbon-steel** pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each **fitting and coupling or valve and coupling**.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inchod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for **cleanouts and drains** specified in Division 22 Section "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:
1. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make fixture and equipment connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water**. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1-inch wg**. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping **NPS 3** and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping **NPS 4** and larger shall be the following:

1. Hubless, cast-iron soil pipe and fittings **heavy-duty** hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping **NPS 3** and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Aboveground, vent piping **NPS 4** and larger shall be the following:

1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping **NPS 3** and smaller shall be **any of** the following:

1. Hubless, cast-iron soil pipe and fittings **CISPI** hubless-piping couplings; and coupled joints.
2. **Solid-wall** PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping **NPS 4** and larger shall be **any of** the following:

1. Hubless, cast-iron soil pipe and fittings **heavy-duty** hubless-piping couplings; and coupled joints.
2. **Solid-wall** PVC pipe, PVC socket fittings, and solvent-cemented joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

H. Aboveground sanitary-sewage force mains **NPS 1-1/2 and NPS 2** shall be the following:
1. Galvanized-steel pipe, pressure fittings, and threaded joints.

I. Mechanical Rooms & Kitchen Underground soil, waste, and vent piping any size shall be the following:
1. NPS 3 and smaller: Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
2. NPS 4 and larger: Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.

END OF SECTION 221316

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Channel drainage systems.
4. Roof flashing assemblies.
5. Through-penetration firestop assemblies.
6. Miscellaneous sanitary drainage piping specialties.
7. Flashing materials.

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 SEISMIC REQUIREMENTS

A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor, I*p*, shall be taken as 1.5 if any of the following conditions apply:

1. The component is required to function for life-safety purposes after an earthquake.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

B. All other components shall be assigned a component importance factor, I*p*, equal to 1.0.

C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 " Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.4 DEFINITIONS

A. FOG: Fats, oils, and greases.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.

b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Sun Drainage Products

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Oatey.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Light Commercial Operation.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
h. Sun Drainage Products

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Sun Drainage Products

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: See Schedule at end of this Section:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Sun Drainage Products

3. Standard: ASME A112.6.3.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Not required.
7. Outlet: Bottom.
8. Trap Material: Cast iron>.
9. Trap Pattern: Deep-seal P-trap>.
10. Trap Features: Trap-seal primer valve drain connection>.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ProSet Systems Inc.

3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
4. Size: Same as connected soil, waste, or vent stack.

5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch- minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch > above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Cap Filters:

1. Description: Activated carbon filter in housing for installation at vent terminal as manufactured by Sweet Filter.
2. Size: Same as connected stack vent or vent stack.

2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

C. Fasteners: Metal compatible with material and substrate being fastened.

D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.6 MOTORS

A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent cap filters on each vent pipe passing through roof.

M. Install wood-blocking reinforcement for wall-mounting-type specialties.

N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

B. Related Sections include the following:

1. Division 22 Section "Sump Pumps."

1.3 DEFINITIONS

A. LLDPE: Linear, low-density polyethylene plastic.

B. PE: Polyethylene plastic.

C. PVC: Polyvinyl chloride plastic.

D. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:
1. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

C. Field quality-control inspection and test reports.

D. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301. All waste, vent, sewer and storm lines shall be soil pipe and fittings that conform to the requirements of CISPI Standard 301, ASTM A ** and shall be marked with the collective trademark of the Cast Soil Pipe Institute or Receive Prior approval of the engineer and manufactured by AB&I Foundry, Tyler Pipe, or Charlotte Pipe. **In addition all Cast iron shall be American made and tested, no “non compliant” import cast iron will be permitted.**

A. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO.
b. Ideal
c. Mission Rubber Company; a division of MCP Industries, Inc.

d. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Husky HD 2000.
b. Clamp-All Corp HI-TORQ 80.
c. Ideal HD
d. Mission HW.
e. Tyler Pipe Widebody.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

2.5 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Mission Rubber Co.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:

1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.

C. Underground storm drainage piping shall be the following (to 6” above finished floor):

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Hub-and spigot cast-iron soil pipe, hub-and spigot cast-iron soil pipe fittings, neoprene rubber gasket, and compression joints.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Fire Plumbing."

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 1 percent downward in direction of flow.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install underground PVC storm drainage piping according to ASTM D 2321.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results Plumbing."

B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221413

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SECTION 221423

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following storm drainage piping specialties:

1. Cleanouts.
2. Roof drains.
3. Miscellaneous storm drainage piping specialties.
4. Flashing materials.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Waste Piping Specialties" for backwater valves, floor drains, trench drains and channel drainage systems connected to sanitary sewer, air admittance valves, FOG disposal systems, grease interceptors and removal devices, oil interceptors, and solid interceptors.

1.3 DEFINITIONS

A. PUR: Polyurethane plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Sioux Chief Manufacturing Company, Inc
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
    h. Sun Drainage Products

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. Oatey.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Light Commercial Operation.
    h. Zurn Plumbing Products Group; Specification Drainage Operation.
    i. Sun Drainage Products

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: [Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.

10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Sioux Chief Manufacturing Company, Inc
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
    h. Sun Drainage Products

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 ROOF DRAINS

A. Metal Roof Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: See Schedule at end of this section for drain descriptions:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Sioux Chief Manufacturing Company, Inc
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
    h. Sun Drainage Products

3. Standard: ASME A112.21.2M.
4. Body Material Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Dome Material: Cast iron.
7. Extension Collars: Required.
8. Underdeck Clamp Required.

9. Sump Receiver: Required.

B. Conductor Nozzles DSN-1:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 FLASHING MATERIALS

A. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

F. Install manufactured downspout boots at grade with top 18 inches above grade. Secure to building wall.

G. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

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SECTION 223100

DOMESTIC WATER SOFTENERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial water softeners.

1. Chemicals.
2. Water testing kits.

1.3 SEISMIC REQUIREMENTS

A. Component Importance Factor. All plumbing components shall be assigned a component importance factor. The component importance factor, I*p*, shall be taken as 1.5 if any of the following conditions apply:

1. The component is required to function for life-safety purposes after an earthquake.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

B. All other components shall be assigned a component importance factor, I*p*, equal to 1.0.

C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 " Vibration and Seismic Controls for Plumbing Piping and Equipment.

1. For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."

2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

1.4 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Water Softeners. Include rated capacities, operating characteristics, furnished specialties, and accessories.
2. Water testing kits.

B. Shop Drawings: For water softeners. Include plans, elevations, sections, details, and connections to piping systems.

1. Wiring Diagrams: Power, signal, and control wiring.

A. Manufacturer Seismic Qualification Certification: Submit certification that plumbing equipment and components will withstand seismic forces defined in Division 22 Section "Mechanical Vibration and Seismic Controls." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Manufacturer Certificates: Signed by manufacturers certifying that water softeners comply with requirements.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

G. Maintenance service agreement.

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water softeners and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, where indicated.

D. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures of mineral and brine tanks.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.
    d. Attrition loss of resin exceeding 3 percent per year.
    e. Mineral washed out of system during service run or backwashing period.
    f. Effluent turbidity greater and color darker than incoming water.
    g. Fouling of underdrain system, gravel, and resin, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.

2. Commercial Water Softener, Warranty Period: From date of Substantial Completion.

    a. Mineral Tanks: 10 years.
    b. Brine Tanks: Five years.
    c. Controls: 10 years.
    d. Underdrain Systems: Five years.

1.9 MAINTENANCE SERVICE

A. Maintenance: Submit four copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one-year renewal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 COMMERCIAL WATER SOFTENERS

A. Description: Factory-assembled, pressure-type water softener.

1. Manufacturers:

a. Culligan International Company.
b. Kinetico Incorporated.
c. Marlo, Inc.
d. Water & Power Technologies, Inc.
e. Northstar
f. CSI Water Treatment Systems, Inc.
g. ECI
h. Pacific

2. Comply with NSF 61, "Drinking Water System Components--Health Effects."
3. Configuration: Twin unit with two mineral tanks and one brine tank, factory mounted on skid.

4. Mineral Tanks: Steel, electric welded; pressure-vessel quality.

a. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
b. Construction: Fabricated and stamped to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels."
c. Pressure Rating125 psig > minimum.
d. Wetted Components: Suitable for water temperatures from 40 to at least 100 deg F.
e. Freeboard: 50 percent minimum for backwash expansion above normal resin bed level.
f. Handholes: 4 inches round or 4 by 6 inches elliptical, in top head and lower sidewall of tanks 30 inches and smaller in diameter.
g. Manhole: 11 by 15 inches in top head of tanks larger than 30 inches in diameter.
h. Support Legs or Skirt: Constructed of structural steel, welded to tank before testing and labeling.
i. Finish: Hot-dip galvanized on exterior and interior of tank after fabrication unless tank is stainless steel.
j. Finish: Exterior of tank spray painted with rust-resistant prime coat, 2- to 3-mil dry film thickness. Interior sandblasted and lined with epoxy-polyamide coating, 8- to 10-mil dry film thickness.
k. Upper Distribution System: Single, point type, fabricated from galvanized-steel pipe and fittings.

l. Lower Distribution System: Hub and radial-arm or header-lateral type; fabricated from PVC pipe and fittings with individual, fine-slotted, nonclogging PE strainers; arranged for even flow distribution through resin bed.
m. Liner: PE, ABS, or other material suitable for potable water.

5. Controls: Fully automatic; factory mounted on unit and factory wired.

a. Adjustable duration of various regeneration steps.
b. Push-button start and complete manual operation.
c. Electric time clock and switch for fully automatic operation, adjustable to initiate regeneration at any hour of day and any day of week or at fixed intervals.
d. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.
e. Pointer on pilot-control valve shall indicate cycle of operation.
f. Means of manual operation of pilot-control valve if power fails.
g. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:

1) Slow opening and closing, nonslam operation.
2) Diaphragm guiding on full perimeter from fully open to fully closed.
3) Isolated dissimilar metals within valve.
4) Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
5) Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.
6) Sampling cocks for soft water.
7) Special tools are not required for service.

h. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.

1) Meter Control: Equip each mineral tank with signal-register-head water meter that will produce electrical signal indicating need for regeneration on reaching hand-set total in gallons. Design so signal will continue until reset.
2) Demand-Initiated Control: Equip single mineral-tank units with automatic-reset-head water meter that electrically activates cycle controller to initiate regeneration at preset total in gallons. Design so head automatically resets to preset total in gallons for next service run.
3) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to initiate regeneration at preset total in gallons. Design so heads automatically reset to preset total in gallons for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.
4) Demand-Initiated Control: Equip each mineral tank of twin mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tank. Set to repeat with other tank. Include electrical lockout to prevent simultaneous regeneration of both tanks.
5) Demand-Initiated Control: Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meters that electrically activate cycle controllers to automatically regenerate at preset total in gallons. Design so heads automatically reset to preset total in gallons for next service run.

Include electrical lockouts to prevent simultaneous regeneration of more than one tank.

6) Demand-Initiated Control: Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meter in common outlet header that electrically activates cycle controller to automatically regenerate one mineral tank at preset total in gallons and divert flow to other tanks. Set to repeat with other tanks. Include electrical lockouts to prevent simultaneous regeneration of more than one tank.

6. Brine Tank: Combination measuring and wet-salt storing system.

   a. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
   b. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
   c. Size: Large enough for at least four regenerations at full salting.

7. Factory-Installed Accessories:

   a. Piping, valves, tubing, and drains.
   b. Sampling cocks.
   c. Main-operating-valve position indicators.
   d. Water meters.

2.3 WATER TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

2.4 SOURCE QUALITY CONTROL

A. Hydrostatically test mineral tanks before shipment to minimum of one and one-half times pressure rating.

B. Prepare test reports.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Install concrete bases of dimensions indicated for commercial water softeners. Refer to Division 22 Section "Common Work Results for Plumbing."

   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevation required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.2 WATER SOFTENER INSTALLATION

A. Install commercial water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.

B. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

C. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.

D. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

E. Install water testing sets mounted on wall, unless otherwise indicated, and near water softeners.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.

1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
2. Plastic valves are specified in Division 22 Section "Domestic Water Piping."
3. Exception: Water softeners with factory-installed shutoff valves at locations indicated.

E. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping."

1. Exception: Water softeners with factory-installed pressure gages at locations indicated.
2. Exception: Water softeners in hot-water service.

F. Install valved bypass water piping around water softeners.

1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
2. Water piping is specified in Division 22 Section "Domestic Water Piping."
3. Exception: Household water softeners.
4. Exception: Water softeners in hot-water service.

G. Install drains as indirect wastes to spill into open drains or over floor drains.

H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Add water to brine tanks and fill with salt.

1. Commercial Water Softeners: Food-grade salt pellets.

C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:

1. ASTM D 859, "Test Method for Silica in Water."
2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068, "Test Methods for Iron in Water."
4. ASTM D 1126, "Test Method for Hardness in Water."
5. ASTM D 1129, "Terminology Relating to Water."
6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water softeners. Refer to Division 01 "Demonstration and Training" Section

END OF SECTION 223100

SECTION 223400

FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 GENERAL

A. Submit product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories and indicating dimensions, required clearances, methods of component assembly, and piping and wiring connections.

B. Submit wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.

C. UL Standards: Provide water heaters complying with the following:
   1. UL 174, "Household Electric Storage Tank Water Heaters."
   2. UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters."

D. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

E. Listing and Labeling: Provide water heaters that are listed and labeled.
   1. The Terms "Listed" And "Labeled": As defined in the National Electrical Code, Article 100.

F. AGA Standards: Provide water heaters that bear the label of the American Gas Association.

G. AGA Standards: Provide pressure and temperature relief valves that bear the label of the American Gas Association and relieve the entire input of the water heater.

H. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1, "Energy Conservation in New Building Design."

1.2 PRODUCTS

A. Manufacturers:

   1. Sealed Combustion High Efficiency Tank Type Gas-Fired Water Heaters:
      a. A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
      b. Bradford White
      c. State Water Heaters

B. Sealed Combustion High Efficiency Tank Type Gas-Fired Water Heaters: Automatic, commercial, gas-fired, with vertical, 160-psig-rated storage tank, gas burner, integral controls, drain valve, gas regulator, relief valve, and vent kit.
   1. Fuel: Natural gas.

2. Insulation: Fiberglass, surrounding tank.
3. Jacket: Steel, with baked-on enamel finish.
4. Tank: Glass-lined steel, with anode rods and drain valve.
5. Controls: Adjustable thermostat.
6. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature in tank.
7. Temperature and Pressure Relief Valve: AGA rated and labeled.

C. Provide concrete bases as indicated.
1. Concrete: Portland cement; mix to a 4000-psi, 28-day compressive strength.
   a. Cement: ASTM C 150, Type I.
   b. Fine Aggregate: ASTM C 33, sand.
   c. Coarse Aggregate: ASTM C 33, crushed gravel.
2. Reinforcement Fabric: ASTM A 185, welded wire fabric, plain.
3. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

D. Earthquake Bracing Assemblies: Commercial concrete floor mounted steel angle bracing with steel water heater straps.

E. Steel, Precharged Water Storage Tanks:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Covert Pump Div.; Covert Manufacturing, Inc.
   d. Expanflex, Inc.
   e. GSW Water Products Co.
   f. A.O. Smith; Aqua-Air Div. (Available from Goulds Pumps, Inc.)
   g. State Industries, Inc.
   h. John Wood Co.

1. Watts.General: Provide precharged, vertical, steel water storage tanks of sizes and capacities as indicated.

2. Operation: Factory-installed, butyl-rubber diaphragm.

3. Operation: Factory-installed, butyl-rubber bladder.

4. Construction: ASME Code, steel, constructed with welded joints, for 125 psig working pressure, and factory-precharged to minimum system operating pressure at tank, as indicated.

5. Interior Lining: Epoxy of thickness that meets requirements of applicable AWWA or FDA and EPA regulatory standards for tasteless and odorless, potable water tank linings.

6. Interior Lining: Polypropylene of thickness that meets requirements of applicable AWWA or FDA and EPA regulatory standards for tasteless and odorless, potable water tank linings.

7. Tappings: Provide tappings of sizes and in locations as indicated. Provide 1 tapping to serve as both inlet and outlet connection.
   a. Tappings 2 Inches and Smaller: Factory-fabricated, threaded, female, welded before testing and labeling.
   b. Tappings 2-1/2 Inches and Larger: Factory-fabricated, flanged, welded before testing and labeling.

8. Accessories: Provide air-charging and pressure relief valves and pressure gages as indicated.

1.3 EXECUTION

A. Form concrete equipment bases using framing lumber with form release compounds. Chamfer top edges and corners.
   1. Install reinforcing bars, and place anchor bolts and sleeves using manufacturer's installation template.
   2. Place concrete and allow to cure before installation of equipment.

B. Install water heaters level and plumb on bases in accordance with manufacturer's written installation instructions. Firmly anchor units in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

C. Install thermometers on water heater inlet and outlet piping.

D. Install gas-fired water heaters in compliance with NFPA 54, "National Fuel Gas Code."

E. Piping Installation Requirements: The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Install piping adjacent to equipment arranged to allow servicing and maintenance.
   2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.
      a. Where water heater piping connections are dissimilar metals, make connections with dielectric fittings. specified in Division 15 Section "Basic Piping Materials and Methods."
      b. Install vacuum relief valve in cold water inlet piping.
   3. Connect gas supply piping to burner with drip leg, tee, gas cock, and union; minimum size same as inlet connection. Arrange piping to allow unit servicing.
      a. Install vent piping from gas train pressure regulators and valves to outside the building. Terminate vent piping with brass screened vent cap fitting. Do not combine vents except with approval of local authority.
      b. Install gas pressure regulators where indicated.
   4. Install drain as indirect waste to spill into open drain or over floor drain.
      a. Install drain valve at low point in water piping, for water heaters not having tank drain.
   5. Electrical Connections: Power wiring and disconnect switches are specified in electrical Work.
      a. Grounding: Connect unit components to ground in accordance with the National Electrical Code.
   6. Vent Connections: Direct vent/sealed combustion with vent kit for termination through roof.
   7. Earthquake Bracing Assemblies: Install earthquake bracing secure to structural members per the manufacturer's installation requirements.

F. Field Quality Control: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate and train Owner's maintenance personnel as specified below.
   1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.
   2. Perform the following before start-up final checks:

a. Fill water heaters with water.
b. Check piping systems test complete.
c. Check for piping connections leaks.
d. Check for clear vent.
e. Test operation of safety controls and devices.

3. Perform the following start-up procedures:
   a. Energize circuits.
   b. Adjust operating controls.
   c. Adjust hot water outlet temperature setting.

END OF SECTION 223400

SECTION 224000

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Commercial sinks.
10. Kitchen sinks.
11. Service sinks.

B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Emergency Plumbing Fixtures."
4. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

E. FRP: Fiberglass-reinforced plastic.

F. PMMA: Polymethyl methacrylate (acrylic) plastic.

G. PVC: Polyvinyl chloride plastic.

H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.

3. Slip-Resistant Bathing Surfaces: ASTM F 462.
4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
5. Stainless-Steel Residential Sinks: ASME A112.19.3.
6. Vitreous-China Fixtures: ASME A112.19.2M.
7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
8. Whirlpool Bathtub Fittings: ASME A112.19.8M.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.
13. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

I. Comply with the following applicable standards and other requirements specified for bathtub/shower and shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
8. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Chicago Faucets.
    b. T & S Brass and Bronze Works, Inc.
    c. Moen, Inc.

2.2 BATHTUB/SHOWER FAUCETS

A. Bathtub/Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Chicago Faucets.
    b. Leonard Valve Company.
    c. Moen, Inc.
    d. Powers; a Watts Industries Co.
    e. Symmons Industries, Inc.

f. T & S Brass and Bronze Works, Inc.

2.3 SHOWER FAUCETS

A. Shower Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Faucets.
b. Leonard Valve Company.
c. Moen, Inc.
d. Powers; a Watts Industries Co.
e. Symmons Industries, Inc.
f. T & S Brass and Bronze Works, Inc.

2.4 SINK FAUCETS

A. Sink Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Faucets.
b. T & S Brass and Bronze Works, Inc.
c. Moen, Inc.

2.5 FLUSHOMETERS

A. Flushometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sloan Valve Company.
b. Zurn Plumbing Products Group; Commercial Brass Operation.
c. Moen, Inc.
d. Advanced Modern Technologies Corporation

2.6 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bemis Manufacturing Company.
b. Centoco Manufacturing Corp.
c. Church Seats.
d. Olsonite Corp.
e. Sperzel.

2. Description: Toilet seat for water-closet-type fixture.

    a. Material: Molded, solid plastic with antimicrobial agent.
    b. Configuration: Open front without cover.
    c. Size: Elongated.
    d. Hinge Type: CK, check.
    e. Class: Heavy-duty commercial.
    f. Color: White.

2.7 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Engineered Brass Co.
    b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
    c. McGuire Manufacturing Co., Inc.
    d. Plumberex Specialty Products Inc.
    e. TCI Products.
    f. TRUEBRO, Inc.
    g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. TRUEBRO, Inc.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.8 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Sun Drainage Products

B. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.9 WATER CLOSETS

A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Crane Plumbing, L.L.C./Fiat Products.
c. Eljer.
d. Kohler Co.
e. Advanced Modern Technologies Corporation

2.10 URINALS

A. Urinals:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Eljer.
e. Kohler Co.
f. Advanced Modern Technologies Corporation

2.11 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Briggs Plumbing Products, Inc.
c. Crane Plumbing, L.L.C./Fiat Products.
d. Eljer.
e. Kohler Co.

2.12 COMMERCIAL SINKS

A. Commercial Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkay Manufacturing Co.
    b. Just Manufacturing Company.

2.13 SHAMPOO BOWLS

A. Shampoo Bowls:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Belvedere USA Corporation; a Subsidiary of the Wella Corporation, North America.

2.14 BATHTUBS

A. Bathtubs

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard Companies, Inc.
    b. Briggs Plumbing Products, Inc.
    c. Crane Plumbing, L.L.C./Fiat Products.
    d. Eljer.
    e. Kohler Co.

2.15 SERVICE SINKS

A. Service Sinks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard Companies, Inc.
    b. Commercial Enameling Company.
    c. Eljer.
    d. Kohler Co.
    e. Crane Plumbing, L.L.C./Fiat Products.

2.16 KITCHEN EQUIPMENT

A. Kitchen Equipment (as noted on Kitchen Equipment Schedule):

1. Rough-in and connect to Kitchen equipment as per the Kitchen Equipment Rough-in drawings. Provide all "P" traps required, chrome-plated cast brass. Tail pieces and trap arms shall be chrome-plated 17 ga. brass tubing.
2. Provide Precision Plumbing Products water hammer arrestors upstream of all quick-closing valves, such as on disposers and dishwasher.
3. Gas and water services to portable and countertop appliances shall be connected to equipment with flexible tubing and quick-disconnect fittings. Gas fittings and hoses shall be A.G.A. approved for commercial kitchen equipment.
4. All exposed piping and fittings shall be chrome-plated or stainless steel. Furnish and install stops on all hot and cold water lines at equipment.
5. Provide shut-off valves and unions in all gas, steam and condensate lines at each connection to equipment.
6. All piping penetrations through walls shall be a minimum of 6" above the floor.
7. Provide 3/4" Watts model U5BLP pressure reducing valve on supply line to dishwasher.
8. Provide check valves on supplies to hose sprays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

L. Install toilet seats on water closets.

M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install shower flow-control fittings with specified maximum flow rates in shower arms.

Q. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

S. Set bathtubs and service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

3.8 KITCHEN EQUIPMENT

K-4.1 Through K-42 (as noted on Kitchen Equipment Schedules):

Rough-in and connect to kitchen equipment and fixtures as indicated on the Kitchen Equipment Rough-in Drawings. Provide all “P” traps, tail pieces, indirect waste piping, stops, supplies and shut off valves required.

Provide chrome plated or stainless steel piping for all exposed piping.

Provide cast brass, chrome plated “P” traps and 17 gauge, chrome plated brass, trap arms and indirect waste lines.

Provide water hammer arrestors on supply line to all quick closing valves i.e. disposers, dishwashers, etc.

Provide direct acting pressure reducing valve on water supply to dishwasher, minimum ¾” size.

Provide shut off valves and unions on all gas supplies to fixed equipment.

Provide flexible tubing and quick disconnect fittings for all water and gas connections to portable equipment and sinks. Provide AGA gas fittings and hoses approved for commercial kitchen equipment.

Provide all piping penetrations through walls a minimum of 6” above the finished floor.

Provide Watts Series 7 dual check valve on hot and cold water supply lines to all sensor operated valves and faucets with hand held hoses or wands.

Provide Powers Series e480 thermostatic mixing valve with check valves on inlets at all hand washing sinks.

END OF SECTION 224000

SECTION 23 0100

MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.

B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.

C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warrantees and guarantees as if the Mechanical Contractor had purchased the equipment.

D. Construction Indoor-Air Quality Management
   1. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
      a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
      b. Replace all air filters immediately prior to occupancy.

1.2 SCOPE OF WORK

A. The project described herein is the Hyde Park Middle School. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.

B. This Division will schedule the boiler inspection and pay for all costs associated with certifying the boiler with the state.

1.3 CODES & ORDINANCES

A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable codes:

1. Utah Boiler and Pressure Vessel Rules and Regulations-2019 Edition
2. International Building code- 2021 Edition
3. International Mechanical Code- 2021 Edition
4. International Plumbing Code- 2021 Edition
5. International Fire Code- 2021 Edition
6. International Energy Code- 2021 Edition
7. International Fuel Gas Code- 2021 Edition
8. National Electrical Code- 2021 Edition

1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.
1. Associated Air Balance council (AABC)
2. Air Conditioning and Refrigeration Institute (ARI)
3. Air Diffusion council (ADC)
4. Air Movement and Control Association (AMCA)
5. American Gas Association (AGA)
6. American National Standards Institute (ANSI)
7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing Materials (ASTM)
10. American Water Works Association (AWWA)
11. Cooling Tower Institute (CTI)
12. ETL Testing Laboratories (ETL)
13. Institute of Electrical and Electronic Engineers (IEEE)
14. Hydronics Institute (HI)
15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
16. National Fire Protection Association (NFPA)
17. National Electrical Code (NEC)
18. National Electrical Manufacturers Association (NEMA)
19. National Electrical Safety code (NESC)
20. Utah safety Standard (OSHA), Utah State Industrial Council.
21. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
22. Underwriters Laboratories (UL)
23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
24. Heat Exchanger Institute (HEI)
25. Hydraulic Institute (HI)
26. Thermal Insulation Manufacturer=s Association (TIMA)
27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:
1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer=s data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or

installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

1.6 SUBMITTALS AND SHOP DRAWINGS

A. General: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect manufacturer's data on products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of **14 days.** The first day starts after the day they are received in the engineer's office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within **14 days** of returned submittals. Refer to each specification section for items requiring submittal review**. If the re-submittal is returned a 2nd time for correction the Contractor will provide the specific equipment that is specified on the drawings and/or the specifications.** Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project.

B. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. **In no way** does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification **nor does it relieve** the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. **Regardless of any items overlooked** by the submittal review, the requirements of the contract drawings and specifications **must be followed** and are not waived or superseded **in any way** by the review.

C. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.

D. If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer's current, recognized, hourly rates.

E. Submittal Format: At the contractor's discretion, project submittals may be in either of the formats described in the following paragraphs, but mixing the two formats is not acceptable.

1. Hardcopy Submittal Format: **Six (6)** copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project will be provided for review. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tab for each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within **120 days** of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
    a. Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.

b. Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.

c. Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.

2. Electronic Submittal Format: Identify and incorporate information in each electronic submittal file as follows:

a. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within **120 days** of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.

b. Submitted electronic file shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.

c. Submitted electronic file shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.

d. Submitted electronic file shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.

e. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

f. Name file with submittal number or other unique identifier, including revision identifier.

g. Electronic file shall be completely electronically searchable or it will be rejected.

h. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by:

1) Architect.

i. Transmittal Form for Electronic Submittals:

1) Use one of the following options acceptable to the Owner;

a) Software-generated form from electronic project management software.

b) Electronic form.

2) The Electronic Submittal shall contain the following information:

a) Project name.
b) Date.
c) Name and address of Architect.
d) Name of Construction Manager.
e) Name of Contractor.

f) Name of firm or entity that prepared submittal.
g) Names of subcontractor, manufacturer, and supplier.
h) Category and type of submittal.
i) Submittal purpose and description.
j) Specification Section number and title.
k) Specification paragraph number or drawing designation and generic name for each of multiple items.
l) Drawing number and detail references, as appropriate.
m) Location(s) where product is to be installed, as appropriate.
n) Related physical samples submitted directly.
o) Indication of full or partial submittal.
p) Transmittal number[, numbered consecutively].
q) Submittal and transmittal distribution record.
r) Other necessary identification.
s) Remarks.

j. Metadata: Include the following information as keywords in the electronic submittal file metadata:

1) Project name.
2) Number and title of appropriate Specification Section.
3) Manufacturer name.
4) Product name.

1.7 DRAWINGS AND MEASUREMENTS

A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.

B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.

C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.

D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.

E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.

F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or

work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.

G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

1.9 EXISTING CONDITIONS

A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.

B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.

C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

1.10 EQUIPMENT CAPACITIES

A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.

B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRADES

A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.

B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.

C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.

D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

1.13 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.

B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans

and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.

B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.

B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.

C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.

D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.

B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.

C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.

D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.

E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.

F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.

B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.

B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.

C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.

B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.

C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.

B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 EXCAVATION AND BACKFILLING

A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.

B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

1.25 ACCESS

A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. . If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910

B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.

C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.

D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

1.26 CONCRETE BASES AND INSERTS

A. Bases: The concrete bases shall be provided and installed as work by this divsion. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.

B. All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.

C. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division

D. Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

1.27 CLEANING AND PAINTING

A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.

C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.28 CONTRACT COMPLETION

A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.

C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.

D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.

E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
2. That the circulation of water shall be complete and even.
3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect’s Certificate of Substantial Completion.

7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.29 CURBS

A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23.

1.30 TEST RUN

A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:

A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.

B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

1.32 DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

B. Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

C. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

E. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

F. Maintain adequate ventilation when using cutting torches.

G. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

J. Dispose of demolished items and materials promptly.

K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

L. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

M. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

END OF SECTION 23 0100

SECTION 23 0500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.
12. Link-Seal

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases, and accessible tunnels.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch** maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, **1/8 inch** thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

2.5 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for **250-psig** minimum working pressure at **180 deg F**.

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for **150-** or **300-psig** minimum working pressure as required to suit system pressures.

F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Provide separate companion flanges and steel bolts and nuts for **150-** or **300-psig** minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig** minimum working pressure at **225 deg F**.

H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig** minimum working pressure at **225 deg F**.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Watts Industries, Inc.; Water Products Div

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: **0.0239-inch** minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: **5000-psi**, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES

A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
1. Izod Impact - Notched = **2.05ft-lb/in.** per ASTM D-256
2. Flexural Strength @ Yield = **30,750 psi** per ASTM D-790
3. Flexural Modulus = **1,124,000 psi** per ASTM D-790
4. Elongation Break = 11.07% per ASTM D-638
5. Specific Gravity = 1.38 per ASTM D-792

B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a “Hex Nut Interlock” designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer’s name molded into it.

C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.

D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:

1. 316 Stainless Steel per ASTM F593-95, with a **85,000 psi** average tensile strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

    c. Insulated Piping: One-piece, stamped-steel type with spring clips.

    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

    f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.

    g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.

M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. PVC Steel Pipe Sleeves: For pipes smaller than **NPS 6**.

   b. Steel Sheet Sleeves: For pipes **NPS 6** and larger, penetrating gypsum-board partitions.

   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches** above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

      1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than **6 inches** in diameter.

2. Install cast-iron "wall pipes" for sleeves **6 inches** and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for **1-inch** annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use **3000-psi**, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 LINK SEAL

A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION 230500

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SECTION 23 0514

VARIABLE FREQUENCY MOTOR DRIVES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install variable frequency drive (VFD) system with motors as described in Contract Documents.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers

1. IEEE 519-1992,

1.3 QUALITY ASSURANCE

A. Requirements: Drive shall meet requirements of IEEE 519 as measured at VFD system terminals.

B. Certifications: Completed unit including motor shall be UL or ETL listed and carry appropriate label.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store unit in area free of dirt, vibration, and moisture.

B. Do not allow unit to be exposed to excessive heat or cold.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. General:

1. Provide VFD and motor one coordinated package, warrantied by VFD supplier.
2. Variable Frequency Drive (VFD) System shall be solid state AC to DC converter sinesoidal pulse-width modulation (PWM) type.
3. Unit shall operate on:

a. Input Voltage Greater than 3 H.P. than 460/3/60 less than 3 H.P> than 230/1/60.
b. Input frequency 60 Hz, plus or minus 5 percent.

4. All components of system shall be contained in single enclosure as integrated package.
5. Control power for operator devices and customer connections shall be 120 volts. Control power transformer shall be 'Machine Tool' type and have primary and secondary fusing.
6. Variable Frequency Drive shall be rated for continuous current equal to 105 percent of motor FLA.
7. Rated overload current shall be 120 percent for one minute.
8. Unit shall be adjustable accel / decel time setting from one second to 120 seconds.
9. Unit shall maintain 95 percent or better displacement power factor over entire speed range.

B. Enclosure:

1. NEMA 1 force ventilated enclosure with louver covered exhaust ports, hinged doors, and painted with high-grade enamel.
2. Door mounted operator devices shall be industrial, oil tight.
3. Wall mounted or freestanding as shown on Drawings.

C. Variable Frequency Drive Inverter:

1. Altitude compensated and sized for elevation at which unit will be installed.
2. Capable of operating in ambient temperature of 14 deg F to 122 deg F and humidity of 0 percent to 90 percent non-condensing.
3. Mounted on removable panel along with other components so panel can be removed from enclosure for maintenance or part replacement.
4. Output frequency clamp on drive for setting minimum or maximum output frequency.
5. Supply with door interlock input disconnect motor circuit protector. Door mounted handle shall be able to lock in OFF position.

D. Controls And Safety Equipment:

1. Provide, as minimum, following door mounted operator controls:

    a. HAND / OFF / AUTO Switch.
    b. Local / Remote Selector.
    c. Frequency Setting Speed Selector.
    d. Frequency Indication Meter calibrated in percent speed.
    e. Power on Light.
    f. VFD / Bypass Switch.
    g. VFD Fault Light.
    h. External Fault Light (safeties interlock).
    i. Digital Keypad Programmable Parameter Unit (75 hp and less).

2. Provide minimum of following protective features with alarm display indication:

    a. Over-current shut-off.
    b. Regenerative over voltage.
    c. Electronic Thermal Protector.
    d. Heatsink Overheat.
    e. Instantaneous Power Failure.
    f. Output Ground Fault (Actual phase to phase or phase to ground without damage).

3. Provide following termination points on terminal strip for field connections:

    a. Safeties Interlock.
    b. Remote Start / Stop Contact.
    c. Remote VFD Fault Contact.

d. Remote VFD / Bypass Enable Contact.
e. Remote Electronic Signal Input.

4. Auto Restart shall be initiated by means of automatic time delayed restart after recovering form under voltage or loss of power. Inverter shall not automatically restart after over-current, over-voltage, over-temperature, or other damaging conditions, but shall require manual restart.

    a. Supply inverter with bypass contactor arrangement for transfer to feeder line to operate at constant speed.
    b. Contactors shall be electrically and mechanically interlocked and supplied with adjustable motor overload relay.

5. Provide VFD isolation switch to allow maintenance on VFD while operating in bypass mode. Pre-wired in same enclosure including contactors, input disconnect MCP, motor overload, VFD / Bypass selector switch, and Bypass On light.
6. Provide elapsed time meter.
7. Frequency Jump: Supply drive with capability of being field retrofitted with frequency jump control to avoid operating at point of resonance with natural frequency of machine.
8. Provide VFD unit with computer signal control option through future addition of RS 232 data card.
9. Fault Diagnostics: Drive system shall have non-volatile fault retention so VFDs fault history is available from memory even after power loss.

E. Approved Products:

1. Rockwell Automation, Inc; Allen-Bradley Brand (ABB)

2.2 SOURCE QUALITY CONTROL

A. Before shipping, test each unit and supply certified test report with each unit. Standard test shall include following:

1. Visual inspection consisting of checking unit enclosure, wiring, connections, fasteners, covers, and locking mechanism.
2. High Pot Test:

    a. Apply two times rated voltage plus 1000 volts AC for 60 seconds in accordance with UL 508 on all peripheral drive system power components (circuit breakers, contactors, motor overloads, line reactors, disconnect switches, etc) as complete package.
    b. Include copy of test results in operations manuals.

3. Test devices and lights on control panel devices.
4. Test optional equipment specified with VFD system.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Testing:

1. VFD supplier shall provide three full spectrum harmonic analyses of VFD voltage and current waveforms for each VFD system.
2. Harmonic report shall demonstrate operating harmonic waveforms with VFD's at 100 percent load, 50 percent load, and with motors operating across line.
3. Conduct harmonic tests at start-up and perform in presence of Architect:

    a. Harmonic current distortion measured at VFD input terminals shall not exceed 40 percent of fundamental current drawn by VFD.
    b. Voltage distortion at this point shall not exceed 3 percent of fundamental.
    c. VFD suppler shall provide harmonic control devices to meet above requirements as integral part of ETL or UL listed VFD system.
    d. Compliance with above limits is strictly responsibility of VFD supplier. Adjustments required to bring system to within specified limits shall be performed at no additional cost to Owner.
    e. Harmonic tests shall be published and included in Operation and Maintenance Manual.
    f. Harmonic distortion compliance shall be approved before final acceptance by Owner.

B. Manufacturer's Field Services:

1. Provide field start-up service by authorized factory service representative consisting of system check-out, start-up, and system run.
2. Provide certificate of completion and authorized factory service including operator training and start-up.

END OF SECTION 23 0514

SECTION 23 0518

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated or rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.

b. Chrome-Plated Piping: **One-piece, cast-brass** type with polished, chrome-plated finish.
c. Insulated Piping: **One-piece, stamped-steel type with chrome-plated finish.**
d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish**
f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: **One-piece, cast-brass** type with polished, chrome-plated finish.
g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish**,
h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: **One-piece, cast-brass** type.
i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: **One-piece, stamped-steel type with polished, chrome-plated finish**,
j. Bare Piping 2 inch and Smaller in Equipment Rooms**: One-piece, cast-brass** type with **polished, chrome-plated** finish.
k. Bare Piping in Equipment Rooms Larger than 2 inch: **One-piece, stamped-steel type with chrome- or cadmium-plated finish**, **.**

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 23 0519

METERS AND GAGES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Liquid-in-glass thermometers.
2. Thermowells.
3. Pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Flowmeters.

B. Related Sections:

1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.
2. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Palmer Wahl Instrumentation Group.
    b. Trerice, H. O. Co.
    c. Weiss Instruments, Inc.
    d. Weksler.

2. Standard: ASME B40.200.
3. **Case**: Die Cast aluminum or brass; nominal size unless otherwise indicated.
4. Case Form: **Adjustable angle** type unless otherwise indicated, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
5. **Tube**: Glass with magnifying lens and **blue** organic liquid.
6. Tube Background: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in **deg F.**
7. Window: **Glass**.
8. **Stem:** Copper-plated steel, aluminum, stainless steel, or brass designed for thermowell installation. Stem shall be of length to match thermowell insertion length.

    a. **Design for** Thermowell Installation: Bare stem.

9. Connector: **1-1/4 inches**, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge Div.
    b. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
    c. Ernst Gage Co.
    d. Marsh Bellofram.
    e. Miljoco Corp.
    f. NANMAC Corporation.
    g. Noshok, Inc.
    h. Palmer - Wahl Instruments Inc.
    i. REO TEMP Instrument Corporation.
    j. Tel-Tru Manufacturing Company.
    k. Trerice, H. O. Co.
    l. Weiss Instruments, Inc.
    m. Weksler
    n. WIKA Instrument Corporation.
    o. Winters Instruments.

2. Manufacturers: Same as manufacturer of thermometer being used.
3. Standard: ASME B40.200.
4. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
5. **Material for Use with Copper Tubing: Brass**.
6. **Material for Use with Steel Piping: Brass.**
7. Type: Stepped shank unless straight or tapered shank is indicated.
8. External Threads: **NPS 1/2, NPS 3/4, NPS 1 or NPS 1-1/4** ASME B1.20.1 pipe threads.
9. Internal Threads: **1/2, 3/4, and 1 inch** with ASME B1.1 screw threads.
10. Bore: Diameter required to match thermometer bulb or stem.
11. Insertion Length: Length required to match thermometer bulb or stem.
12. Lagging Extension: Include on thermowells for insulated piping and tubing.
13. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. KOBOLD Instruments, Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Trerice, H. O. Co.
    k. Weiss Instruments, Inc.
    l. Weksler
    m. WIKA Instrument Corporation.
    n. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. **Case:** Liquid-filled type; cast aluminum or drawn steel; **4-1/2-inch**nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated. **NPS 1/4 or NPS 1/2.**
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in **psi .**
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. **Ring: Stainless steel.**
11. **Accuracy: Grade A, plus or minus 1 percent of middle half of scale range**.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AMETEK, Inc.; U.S. Gauge.
    b. Ashcroft Inc.
    c. Ernst Flow Industries.
    d. KOBOLD Instruments, Inc.
    e. Marsh Bellofram.
    f. Miljoco Corporation.
    g. Noshok.
    h. Palmer Wahl Instrumentation Group.
    i. REOTEMP Instrument Corporation.
    j. Trerice, H. O. Co.
    k. Weiss Instruments, Inc.
    l. Weksler
    m. WIKA Instrument Corporation.
    n. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. **Case: Liquid-filled, cast aluminum or drawn steel**; diameter with **back** flange for panel surface mounting or front flange for panel recessed mounting. Flanges to include pre-drilled screw holes.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated. **NPS 1/4 or NPS 1/2.**
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Satin faced, nonreflective aluminum with permanently etched scale markings graduated in **psi** .
8. Pointer: Dark-colored metal.
9. Window: **Glass**.
10. **Ring: Stainless steel.**
11. **Accuracy: Grade A, plus or minus 1 percent of middle half of scale range**.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with ASME B1.20.1 pipe threads. Include extension for use on insulated piping. **NPS 1/4 or NPS 1/2 .**
    1. **Surge-dampening device: porous-metal**-type.

B. Siphons:
    1. Loop-shaped section: Brass pipe with pipe threads. **NPS 1/4 or NPS 1/2.**

C. Valves:
    1. **Needle: Brass**, with **NPS 1/4 or NPS 1/2** ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1. Flow Design, Inc.
    2. MG Piping Products Co.
    3. National Meter, Inc.

4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Twin City Hose.
8. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
9. Welsler.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: or , ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating:

F. Core Inserts: Self-sealing synthetic rubber;
1. EPDM (Nordel) for air, water or glycol operation between **30 and 275 deg F**.
2. CR (Neoprene) for air, water, glycol, oil, or gas operation between **-30 to 200 deg F**.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish the number of test-plug kits given below with the number of thermometers given below, with each kit having one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

1. Low-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch** diameter dial and tapered-end sensing element. Dial range shall be at least **25 to 125 deg F** .
2. High-Range Thermometer: Small, bimetallic insertion type with **1- to 2-inch** diameter dial and tapered-end sensing element. Dial range shall be at least **0 to 220 deg F .**
3. Pressure Gage: Small, Bourdon-tube insertion type with **2- to 3-inch** diameter dial and probe. Dial range shall be at least **to 200 psig.**
4. Carrying Case: Metal or plastic, with formed instrument padding.
5. **One test-plug kit with:**
   a. **Two** thermometers.

2.7 FLOWMETERS

A. Orifice Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB; Instrumentation and Analytical.
    b. Armstrong Pumps Inc.; S. A. Armstrong Limited.
    c. Badger Meter, Inc.; Industrial Div.
    d. Bell & Gossett; ITT Industries.
    e. Meriam Process Technologies.
    f. Spirax Sarco

2. Description: Flowmeter with sensor, hoses or tubing, quick connect hose fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.

    a. Design**:** Differential-pressure-type measurement:
        1) For HVAC hot and chilled **water**.
    b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
    c. Minimum Pressure Rating: **300 psig.**
    d. Minimum Temperature Rating: **250 deg F .**

5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two **12-foot** hoses, with carrying case.

    a. Scale: **Gallons per minute.**
    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range **.**
6. Conversion Chart: Flow rate data compatible with sensor and indicator.
7. Operating Instructions: Include complete instructions with each flowmeter.

B. Turbine Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ABB; Instrumentation and Analytical.
    b. Data Industrial Corp.
    c. EMCO Flow Systems; a division of Spirax Sarco, Inc.
    d. ERDCO Engineering Corp.
    e. Hoffer Flow Controls, Inc.
    f. Liquid Controls; a unit of IDEX Corporation.
    g. McCrometer, Inc.
    h. Midwest Instruments & Controls Corp.
    i. ONICON Incorporated.
    j. SeaMetrics, Inc.
    k. Sponsler, Inc.; a unit of IDEX Corporation.
    l. Spirax Sarco

2. Description: Flowmeter with sensor and indicator.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in **gallons per minute**.

    a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for **water**.
    b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
    c. Minimum Pressure Rating: **150 psig** .
    d. Minimum Temperature Rating: **180 deg F** .

5. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
6. Accuracy: Plus or minus **1-1/2** percent.
7. Display: Shows rate of flow**, with register to indicate total volume in gallons**.
8. Operating Instructions: Include complete instructions with each flowmeter.

C. Venturi Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pump
    b. Badger Meter, Inc.; Industrial Division
    c. Bailey-Fischer & Porter Co.
    d. Flow Design, Inc.
    e. Gerand Engineering Co.
    f. Hyspan Precision Products, Inc.
    g. Leeds & Northrup.
    h. McCrometer, Inc.
    i. Preso Meters; a division of Racine Federated Inc.
    j. Victaulic Company.
    k. Spirax Sarco

2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, quick connect hose fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

    a. Design: Differential-pressure-type measurement for **water.**
    b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
    c. Minimum Pressure Rating: **250 psig .**
    d. Minimum Temperature Rating: **250 deg F .**
    e. End Connections for **NPS 2** and Smaller: Threaded.
    f. End Connections for **NPS 2-1/2** and Larger: Flanged or welded.
    g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Install thermowells**: with socket extending **one-third of pipe diameter** and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions to most readable position.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

G. Install needle-valve and snubber in piping for each pressure gage for fluids. Exception: Steam.

H. Install test plugs in piping tees.

I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

J. Install flowmeter elements in accessible positions in piping systems.

K. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

L. Install permanent indicators on walls or brackets in accessible and readable positions.

M. Install connection fittings in accessible locations for attachment to portable indicators.

N. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

O. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic boiler.
2. Two inlets and two outlets of each chiller.
3. Inlet and outlet of each hydronic coil in air-handling units.
4. Two inlets and two outlets of each hydronic heat exchanger.
5. Inlet and outlet of each thermal-storage tank.
6. Inlet and outlet of each piece of steam equipment.

P. Install pressure gages in the following locations:

1. Inlet and discharge of each pressure-reducing valve.
2. Inlet and outlet of each chilled-water and canal-water connection.
3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be **one of** the following:

1. **Test plug:** With EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hydronic boiler shall be **one of** the following:

1. **Industrial**-style, liquid-in-glass type.

C. Thermometers at inlets and outlets of each chiller shall be **one of** the following:

1. **Industrial**-style, liquid-in-glass type.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be **one of** the following:

1. **Industrial**-style, liquid-in-glass type.

E. Thermometers at inlet and outlet of each hydronic coil at fan coils, cabinet heaters, unit heaters and reheat coils and as shown on details shall be the following:

1. **Industrial**-style, liquid-in-glass type.
2. Test plug with **[CR] [chlorosulfonated polyethylene synthetic]** self-sealing rubber inserts**.**
3. Test plug with **EPDM** self-sealing rubber inserts.

F. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the **one of** following:

1. **Industrial**-style, liquid-in-glass type.

G. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be the **one of** following:

1. **Industrial**-style, liquid-in-glass type.

H. Thermometers at inlet and outlet of each thermal-storage tank shall be **one of** the following:

1. **Industrial**-style, liquid-in-glass type.

I. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: **0 to 100 deg F** .

B. Scale Range for Chilled-Water Piping: **0 to 150 deg F**.

C. Scale Range for Canal-Water Piping: **0 to 150 deg F.**

D. Scale Range for Heating, Hot-Water Piping: **30 to 240 deg F**.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at inlet and discharge of each pressure-reducing valve shall be the **one of** following:

1. Dry-case type, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each chiller chilled-water and canal-water connection shall be **one of** the following:

1. Liquid-filled, **direct**-mounted, metal case.

C. Pressure gages at suction and discharge of each pump shall be **one of** the following:

1. **Liquid-filled**, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water, Canal-Water, Heating, and Hot-Water Piping shall be twice the normal operating pressure of the measured system with gage ranges as follows:

1. 30 in. Hg to 15 psi .
2. 0 to 30 psi .
3. 0 to 100 psi .
4. 0 to 160 psi .
5. 0 to 200 psi .
6. 0 to 300 psi .
7. 0 to 600 psi .

3.8 FLOWMETER SCHEDULE

A. Flowmeters: See specification section 230900 Building Automation System.

END OF SECTION 230519

SECTION 23 0523

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Iron swing check valves.
8. Bronze globe valves.
9. Iron globe valves.
10. Lubricated plug valves.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

B. Maintenance data for valves to be included in the operation and maintenance data specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve as listed in SUMMARY from a single source and from a single manufacturer.

B. Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.
4. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. **Set** angle, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller **except plug valves**.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every **5** plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.

a. **Caution:** Where soldered end connections are used, use solder having a melting point below 840 deg. For, globe, and check valves: below 421 deg. F for ball valves.

3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. APCO Willamette Valve and Primer Corp.
2. Babbitt Steam Specialty Company.
3. Bray Controls.
4. Center Line.
5. Cla-Val Company.
6. Conbraco Industries Inc.
7. Crane Co.; Crane Valve Group.
8. Fisher Valve by Emerson.
9. Flo Fab Inc.
10. Flow-Tek Inc.
11. Grinnell Corporation.
12. Hammond Valve.
13. Jamesbury; a subsidiary of Metso Automation.
14. Jomar International LTD.
15. Keystone Valve USA, Inc.
16. Kitz Corp.
17. Metraflex Company.
18. Milwaukee Valve Company.

19. Mueller Steam Specialty.
20. NIBCO Inc.
21. Red-White Valve Corp.
22. Spence Strainers International.
23. Stockham Valves and Fittings, Inc.
24. Tyco Fire/Shurjoint Piping Products.
25. Tyco/Pentair LTD.
26. Val-Matic Valve & Mfg. Corp.
27. Victaulic Company.
28. Watts Regulator Company.

2.4 BRONZE BALL VALVES

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

1. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 150 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. **Disc: Nylon 11 coated ductile iron**.

B. 175 CWP, Iron, Single-Flange (Lug) Butterfly Valves:

1. Description:
   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.

g. **Disc:** Nylon 11 coated ductile iron.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and **Nylon 11 coated ductile Iron** Disc:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. **Disc:** Nylon 11 coated ductile iron.

D. 250 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and **Nylon 11 coated ductile Iron** Disc:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 250 psig.
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. **Disc:** Nylon 11 coated ductile iron.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valve:

1. Description:

a. Standard: MSS SP-80.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61, ASTM B 62, bronze.
e. **Ends: Threaded**.
f. **Disc: Bronze, Type 1**.

2.7 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.

e. Ends: Threaded.
f. Disc: Bronze.

2.8 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.9 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Teflon impregnated, asbestos free.
h. **Handwheel: Malleable iron**.

2.10 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Stem: Brass alloy. OS &Y.
f. Disc: Renewable bronze seat.
g. Trim: Bronze.
h. Packing and Gasket: Teflon impregnated, asbestos free.
i. Handwheel: Cast iron

2.11 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Description:

    a. Standard: MSS SP-78, Type II.
    b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
    c. **Pattern: Regular or short**.
    d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
    e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance3 with requirements for installation tolerances and other conditions affecting performance of valves. Do no proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves as indicated, according to manufacturer’s written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.
4. Install all check valves a minimum of five pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. In extreme cases add flow straighteners as required to correct the turbulence.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. **Shutoff Service: Ball** or **butterfly** valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. **Throttling Service except Steam: Globe** valves.
4. **Throttling Service, Steam: Globe** valves.
5. Pump-Discharge Check Valves:

    a. **NPS 2 and Smaller:** Bronze swing check valves with **bronze** disc.
    b. **NPS 2-1/2 and Larger:** Iron swing check valves with lever and weight or with spring or iron, **metal**-seat check valves.

6. Drain Service (except Steam): Two-Piece, Full Port Bronze Ball Valves with Bronze Trim. To be installed with NPS ¾ hose thread outlet and hose cap with chain.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. **Bronze Valves:** May be provided with solder-joint ends instead of threaded ends.
3. Ball Valves:
    a. **Piece: Two**
    b. **Port: Full.**
    c. **Material/Trim: Bronze with:**
        1) **Bronze** trim.

4. Bronze Swing Check Valves:
   a. Class 150
   b. **Bronze** disc.
6. Bronze Globe Valves:
   a. Class 125
   b. **Bronze** disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
   a. 200 CWP,
   b. **Seat: EPDM.**
   c. **Disc: Ductile-iron**.
3. **Iron Swing Check Valves: Class 125**, metal seats.
4. **Iron Globe Valves: Class 125**.
5. **Lubricated Plug Valves: Class 125**, **regular gland**, **flanged.**

3.6 CANAL-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. **Bronze Valves:** May be provided with solder-joint ends instead of threaded ends.
3. Ball Valves:
   a. **Piece: Two**
   b. **Port: Full.**
   c. **Material/Trim: Bronze with:**
      1) **Bronze** trim.
4. Bronze Swing Check Valves:
   a. Class 150
   b. **Bronze** disc.
6. Bronze Globe Valves:
   a. Class 125
   b. **Bronze** disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
   a. 200 CWP,
   b. **Seat: EPDM.**
   c. **Disc: Ductile-iron**.
3. **Iron Swing Check Valves**: **Class 125**, **metal** seats.
4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and [**spring**] [**weight**].
6. **Iron Globe Valves: Class 125**.
7. **Lubricated Plug Valves: Class 125**, **regular gland**, **flanged.**

3.7 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. **Bronze Valves:** May be provided with solder-joint ends instead of threaded ends.
3. Ball Valves:
   a. **Piece: Two**
   b. **Port: Full.**
   c. **Material/Trim: Bronze with:**
      1) **Bronze** trim.
4. Bronze Swing Check Valves:
   a. Class 150
   b. **Bronze** disc.
6. Bronze Globe Valves:
   a. Class 125
   b. **Bronze** disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
   a. 200 CWP,
   b. **Seat: EPDM.**
   c. **Disc: Ductile-iron**.
3. **Iron Swing Check Valves: Class 125**, metal seats.
4. **Iron Globe Valves: Class 125**.

END OF SECTION 230523

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.

B. Related Sections:

1. **Division 05** for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to **ASCE/SEI 7**.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: **Signed and sealed by a qualified professional engineer**. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO/Michigan Hanger Co. ; ERISTRUT Div.
   d. FNW/Ferguson Enterprises
   e. GS Metals Corp.
   f. Hilti, Inc.insert manufacturer's name.
   g. Power-Strut Div. Tyco International.
   h. Thomas & Betts Corporation.
   i. Tolco Inc.
   j. Unistrut; an Atkore International company.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
   a. Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Anvil International; a subsidiary of Mueller Water Products, Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. FNW/Ferguson Enterprises
   e. Haydon Corporation.
   f. NIBCO INC.
   g. PHD Manufacturing, Inc.
   h. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
7. Coating:
   a. Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping:
1. **Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig** minimum compressive strength.

C. Insulation-Insert Material for Hot Piping:
1. **Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig** minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: **5000-psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

G. Install lateral bracing with pipe hangers and supports to prevent swaying.

H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and

larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

K. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating **above** Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating **below** Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for **trapeze pipe hangers**.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches**.

3.4 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in **Division 09**.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel **pipe hangers and supports** and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24.**
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): **750 lb**.
    b. Medium (MSS Type 32): **1500 lb**.
    c. Heavy (MSS Type 33): **3000 lb**.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use **powder-actuated fasteners** instead of building attachments where required in concrete construction.

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SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. Provide engineered vibration isolation and restraint systems in accordance with the requirements of this section including design, engineering, materials, testing, inspections and reports.

B. Mechanical equipment with moving parts shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.

C. All mechanical equipment, piping and ductwork shall be restrained as required by Federal, State and Local building codes to preserve the integrity of nonstructural building components during **seismic** events to minimize hazards to occupants and reduce property damage.

1.3 SUMMARY

A. This Section includes the following:
1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
14. Snubbers.
15. Restraint channel bracings.
16. Restraint cables.
17. Seismic-restraint accessories.
18. Mechanical anchor bolts.
19. Adhesive anchor bolts.
20. Vibration isolation equipment bases.
21. Restrained isolation roof-curb rails.
22. Certification of **seismic** restraint designs.

23. Installation supervision.
24. Design of attachment of housekeeping pads.
25. All components requiring IBC compliance and certification.
26. All inspection and test procedures for components requiring IBC compliance.
27. Restraint of all mechanical equipment, pipe and ductwork, within, on, or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
28. Seismic certification of equipment

1.4 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. ASCE: American Society of Civil Engineers

D. OSHPD: Office of Statewide Health Planning and Development for the State of California.

E. Ip: Importance Factor.

F. ESSENTIAL FACILITIES, (Occupancy Category IV, IBC-2012)

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

G. LIFE SAFETY

1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels.

2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers.

3. All medical and life support systems.

4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature.

5. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually-operated systems used for smoke evacuation, purge or fresh air relief by the fire department.

6. Heating systems in any facility with Occupancy Category IV, IBC-2009 where the ambient temperature can fall below 32 degrees Fahrenheit.

1.5 REFERENCE CODES AND STANDARDS

A. Codes and Standards: The following shall apply and conform to good engineering practices unless otherwise directed by the Federal, State or Local authorities having jurisdiction.

1. IBC
2. ASCE 7
3. NFPA 13 (National Fire Protection Association)
4. IBC 2012 replaces all references to IBC 2006, 2009.

B. The following guides may be used for supplemental information on typical seismic installation practices. Where a conflict exists between the guides and these construction documents, the construction documents will preside.

1. FEMA (Federal Emergency Management Agency) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.
2. SMACNA (Sheet Metal and Air-conditioning Contractors' National Association) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd ed.
3. ASHRAE (American Society for Heating, Refrigerating and Air-conditioning Engineers) A Practical Guide to Seismic Restraint
4. MSS (Manufacturers Standardization Society of the Valve and Fittings Industry) MSS SP-127, Bracing for Piping Systems, Seismic – Wind – Dynamic, Design, Selection, Application.

1.6 ISOLATOR AND RESTRAINT MANUFACTURER'S RESPONSIBILITIES:

A. Provide project specific vibration isolation and seismic restraint design prepared by a registered design professional in the state were the project is being constructed, and manufacturer certifications that the components are seismically qualified.

1. Provide calculations to determine restraint loads resulting from seismic forces as required by IBC, Chapter 16 and ASCE 7, latest editions. Seismic calculations shall be certified by an engineer licensed in the state where the project is being constructed.

B. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.

1. Provide seismic restraint details with specific information relating to the materials, type, size, and locations of anchorages; materials used for bracing; attachment requirements of bracing to structure and component; and locations of transverse and longitudinal sway bracing and rod stiffeners.
2. Provide seismic bracing layout drawings indicating the location of all seismic restraints.

    a. Each piece of rotating isolated equipment shall be tagged to clearly identify quantity and size of vibration isolators and seismic restraints.

C. Provide, in writing, the special inspection requirements for all Designated Seismic Systems as indicated in Chapter 17 of the IBC.

D. Provide training for installation, operation and maintenance of isolation and restraint systems.

1.7 PERFORMANCE REQUIREMENTS

A. Flood-Restraint Loading: Per the structural drawings and specifications.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: Per the structural drawings and specifications.
2. Assigned Occupancy Category as Defined in the IBC: Per the structural drawings and specifications.

    a. Component Importance Factor: 1.5.
        1) Life safety components required to function after an earthquake.
        2) Components containing hazardous or flammable materials in quantities that exceed the exempted amounts for an open system listed in Chapter 4.
        3) For structures with an Occupancy Category IV, components needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
        4) Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
    b. Component Importance Factor: 1.0.
        1) All other components
    c. Component Response Modification Factor: Per the structural drawings and specifications.
    d. Component Amplification Factor: Per the structural drawings and specifications.

3. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.
4. Design Spectral Response Acceleration at 1-Second Period: Per the structural drawings and specifications.

1.8 ACTION SUBMITTALS

A. Product Data: For the following:

1. Submittals shall include catalog cut sheets and installation instructions for each type of anchor and seismic restraint used on equipment or components being isolated and/or restrained.
2. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated load, rated deflection, and overload capacity for each vibration isolation device.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an **evaluation service member of ICC-ES**.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. "Basis for Design" report: Statement from the registered design professional that the design complies with the requirements of the ASCE 7-05 Chapter 13, IBC 2009 chapter 1912 and ACI 318. In addition, the basis for compliance must also be noted, as listed below:

    a. Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
    b. Submittal of the manufacturer's certification that the isolation equipment is seismically qualified by:
    c. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
    d. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
    e. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

2. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer. Copies of testing and calculations must be submitted as part of submittal documents. OSHPD pre-approved restraint systems are exempt from this requirement if their pre-approval is current and based upon the IBC 2009 (i.e. OPA-07 pre-approval numbers).

3. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

4. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, **seismic** forces required to select vibration isolators, **seismic** restraints, and for designing vibration isolation bases.

    a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.

5. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
6. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
7. **Seismic**-Restraint Details:

    a. Design Analysis: To support selection and arrangement of **seismic** restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: By **an evaluation service member of ICC-ES**, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.9 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

1. Submittal drawings and calculations must be stamped by a registered professional engineer in the State where the project is being constructed who is responsible for the seismic restraint design.
2. Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.10 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

1.11 SEISMIC CERTIFICATION OF EQUIPMENT

A. Component Importance Factor. All plumbing and mechanical components shall be assigned a component importance factor. The component importance factor, I*p*, shall be taken as 1.5 if any of the following conditions apply:

1. The component is required to function for life-safety purposes after an earthquake.
2. The component contains hazardous materials.
3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.

B. All other components shall be assigned a component importance factor, I*p*, equal to 1.0.

C. For equipment or components where I*p* = 1.0.

1. Submit manufacturer's certification that the equipment is seismically qualified by:

   a. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
   b. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
   c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

2. The equipment and components listed below are considered rugged and shall not require Special Seismic Certification:

   a. Valves (not in cast-iron housings, except for ductile cast iron).
   b. Pneumatic operators.
   c. Hydraulic operators.
   d. Motors and motor operators.
   e. Horizontal and vertical pumps (including vacuum pumps).
   f. Air compressors
   g. Refrigerators and freezers.
   h. Elevator cabs.
   i. Underground tanks.
   j. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with Chapter 13, ASCE 7.

3. Rugged equipment and components in this section are for factory assembled discrete equipment and components only and do not apply to site assembled or field assembled equipment or equipment anchorage. The list is based in part on OSHPD Code Application Notice 2-1708A.5.

D. Special Certification requirements for Designated Seismic Systems (i.e. I*p* = 1.5): Seismic Certificates of Compliance supplied by manufacturers shall be submitted for all components that are part of Designated Seismic Systems. In accordance with the ASCE 7, certification shall be via one of the following methods:

1. For active mechanical and electrical equipment that must remain operable following the design earthquake:

   a. Testing as detailed by part C.1.b above.
   b. Experience data as detailed by part C.1.c above.
   c. Equipment that is considered "rugged" per part C.2 above.

2. Components with hazardous contents shall be certified by the manufacturer as maintaining containment following the design earthquake by:

   a. Testing as detailed by part C.1.b above.
   b. Experience data as detailed by part C.1.c above.
   c. Engineering analysis utilizing dynamic characteristics and forces. Tanks (without vibration isolators) designed by a registered design professional in accordance with ASME Boiler and Pressure Vessel Code, and satisfying the force and

displacement requirements of Sections 13.3.1 and 13.3.2 of ASCE 7 having an importance factor, I*p* = 1.0 shall be considered to satisfy the Special Seismic Certification requirements on the basis of ASCE 7 Section 13.6.9.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. CalDyn (California Dynamics Corporation).
3. ISAT (International Seismic Application Technology).
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-Acoustics
7. VMC (Vibration Mountings & Controls, Inc.)

B. Elastomeric Isolation Pads **P1**:

1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Pad Material: Oil and water resistant with elastomeric properties.
4. Surface Pattern: **Ribbed** pattern.
5. Load-bearing metal plates adhered to pads.

C. Double-Deflection, Elastomeric Isolation Mounts **M1**:

1. Mounting Plates:

   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded, or with threaded studs or bolts.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

D. Restrained Elastomeric Isolation Mounts **M2**:

1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

   a. Housing: Cast-ductile iron or welded steel.
   b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

E. Spring Isolators **S1**: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators **S2**: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Baseplates shall limit floor load to 500 psig.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Restrained Spring Isolators **S3**: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with **adjustable** snubbers to limit vertical movement.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric pad: For high frequency absorption at the base of the spring.

H. Elastomeric Hangers **H1**:

1. Description: Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods

a. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
b. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

I. Spring Hangers **H2**: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and Insert in Compression.
   a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   g. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop **H3**: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and insert in Compression and vertical limit stop.

   a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   h. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support **R1**:

1. Description: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene.

   a. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

b. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

L. Resilient Pipe Guides **R2**:

1. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.

a. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

M. Horizontal Thrust Restraints **T1**: Modified specification S2 isolator.

1. Horizontal thrust restraints shall consist of a modified specification S2 spring mounting. Restraint springs shall have the same deflection as the isolator springs.
2. The assembly shall be preset at the factory and fine tuned in the field to allow for a maximum of 1/4" movement from stop to maximum thrust.
3. The assemblies shall be furnished with rod and angle brackets for attachment to both the equipment and duct work or the equipment and the structure.
4. Restraints shall be attached at the center line of thrust and symmetrically on both sides of the unit.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. CalDyn (California Dynamics Corporation).
3. ISAT (International Seismic Application Technology).
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-Acoustics
7. VMC (Vibration Mountings & Controls, Inc.)

B. Restrained Vibration Isolation Roof-Curb Rails: **RC1**:

C. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.

D. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist **seismic** forces.

E. Lower Support Assembly: The lower support assembly shall be a formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.

F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are

accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic and wind restraint.

    a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
    b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
    e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch-thick.

H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

I. All roof curbs shall be at least 8-inches (MIN) above the roof membrane.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. CalDyn (California Dynamics Corporation).
3. ISAT (International Seismic Application Technology).
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-Acoustics
7. VMC (Vibration Mountings & Controls, Inc.)

B. Steel Bases and Rails **SB1**: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base **IB1**: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than **2-inch** clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

    a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. CalDyn (California Dynamics Corporation).
3. ISAT (International Seismic Application Technology).
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibro-Acoustics
7. VMC (Vibration Mountings & Controls, Inc.)

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by **an evaluation service member of ICC-ES**.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

D. Channel Support System: MFMA-4, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

E. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Cables located in exterior or other wet locations such as wash-down areas shall be stainless steel.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

G. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

M. All post installed anchors utilized in the seismic design must be qualified for use in cracked concrete and approved for use with seismic loads.

N. Expansion anchors shall not be used for anchorage of equipment with motors rated over 10 HP with the exception of undercut expansion anchors. Spring or internally isolated equipment are exempt from this requirement.

O. All beam clamps utilized for vertical support must also incorporate retention straps.

P. All seismic brace arm anchorages to include concrete anchors, beam clamps, truss connections, etc., must be approved for use with seismic loads.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and **seismic** control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and **seismic** control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in **Divison 03 Section "Cast-in-Place Concrete**."

B. Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 4,000 psi or as specified by the project engineer. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space, embedment and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.

C. Housekeeping pads shall have adequate space to mount equipment and seismic restraint devices.

D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors and shall also be large enough and thick enough to ensure adequate edge distance and embedment depth for restraint anchor bolts to avoid housekeeping pad breakout failure. Refer seismic restraint manufacturer’s written instructions.

E. Coordinate with vibration/seismic restraint manufacturer and the structural engineer of record to locate and size structural supports underneath vibration/seismically restrained equipment (e.g. roof curbs, cooling towers and other similar equipment). Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer’s written instructions. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer’s written instructions.

3.3 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by **an evaluation service member of ICC-ES** and per the seismic restraint manufacturer’s design.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

C. Isolate all mechanical equipment 0.75 hp and over per the isolator and seismic restraint schedule and these specifications. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections

D. All isolation materials and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data

E. Installation of all vibration isolation materials, flexible connectors and supplemental equipment bases specified in this section shall be accomplished as per the manufacturer's written instructions with mountings adjusted to level equipment. Any variance or non-compliance with the manufacturer's instructions shall be reviewed and approved in writing by the manufacturer or corrected by the contractor in an approved manner.

F. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.

G. Locate isolation hangers as near to the overhead support structure as possible.

H. No rigid connections between isolated components and the building structure shall be made that degrades the noise and vibration control system herein specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls. "Components" includes, but is not limited to, mechanical equipment, piping and ducts.

I. Coordinate work with other trades to avoid rigid contact with the building.

J. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.

K. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.

L. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.

M. Use horizontal thrust restraints **T1** to protect Air handling equipment and centrifugal fans against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight.

N. Isolated equipment, duct and piping located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure will not be acceptable.

O. On completion of installation of all isolation materials and before startup of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.

P. All floor mounted isolated equipment shall be protected with specification M1, M2, S1, S2 or S3 isolator.

Q. Horizontal Pipe Isolation: All HVAC pumped water, pumped condensate, glycol, and refrigerant piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first three (3) support locations from externally isolated equipment provide specification H2 or H3 hangers or specification S1, S2 or S3 mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification H2 or H3 hangers, or specification S1 or S2 mounts with the same deflection as equipment isolators but a minimum of ¾".

R. Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall conform to the pipefitting schedule. Control rods or protective braid must be used to limit elongation to 3/8". Flexible connectors shall not be required for suspended in-line pumps.

S. All plumbing pumped water, piping size 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping above. Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule.

T. Pipe Riser Isolation: The operating weight of all variable temperature vertical pipe risers 1-1/4" and larger, requiring isolation where specifically shown and detailed on riser drawings shall be fully supported by specification M1, M2 or R1 supports. S1, S2, S3, H2 or H3 steel spring deflection isolators with minimum 3/4-inch minimum shall be in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Height saving brackets used with isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Specification R1 riser supports shall be installed near the center point of the riser to anchor the riser when spring isolation is used. Specification R2 riser guides may be used in conjunction with spring isolators per design calculations. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed.

U. Where riser pipes pass through cored holes, core diameters shall be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. Where seismic restraint is required specification isolator S3 shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints.

V. Duct Isolation: Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type H2 or H3 hangers or type S1 or S2 floor mounts.

3.5 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. On projects with Seismic Site Class A or B, seismic design or restraint is not required.

2. On projects with Seismic Design Category C: Components with an importance factor of 1.0 do not require seismic design or restraint.

3. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

4. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

5. Install seismic-restraint devices using methods approved by **an evaluation service member of ICC-ES** providing required submittals for component.

6. Suspended Equipment: All suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:

    a. Rigidly attached to pipe or duct that is 75 lbs. and greater,
    b. Items greater than 20 lbs and distribution systems weighing more than 5 lbs/lineal foot, with an importance factor of 1.0 hung independently or with flexible connections.
    c. Possibility of consequential damage.
    d. For importance factors greater than 1.0 all suspended equipment requires seismic restraint regardless of the above notes.
    e. Wall mounted equipment weighing more than 20 lbs.
    f. Exemptions:

        1) Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an Ip = 1.0 and where flexible connections exist between the component and associated ductwork, piping or conduit.

7. Base Mounted Equipment: All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified by the supplier:

    a. Connections to or containing hazardous material,
    b. With an overturning moment.
    c. Weight greater than 400 lbs.
    d. Mounted on a stand 4 ft. or more from the floor
    e. Possibility of consequential damage.

f. For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.
g. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
h. Exemptions:

1) Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor, Ip = 1.0, the components are mounted at 4 feet or less above a floor level, flexible connections between the components and associated duct work, piping and conduit are provided and there is no possibility of consequential damage.

8. Roof Mounted Equipment:
   a. To be installed on a structural frame, seismically rated roof curb, or structural curb frame mechanically connected to the structure. Items shall not be mounted onto sleepers or pads that are not mechanically and rigidly attached to the structure. Restraint must be adequate to resist both seismic and wind forces.
   b. Roof curbs shall be installed directly to building structural steel or concrete roof deck and not to top of steel deck or roofing material.
   c. Exemptions:
      1) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.

9. Rigid Mounted Equipment:

   a. Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
   b. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
   c. Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.

10. Vibration Isolated Equipment:

    a. Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
    b. Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8” gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.

B. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

C. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

D. Install seismic-restraint devices using methods approved by **an evaluation service member of ICC-ES** providing required submittals for component.

E. Installation and adjustment of all seismic restraints specified in this section shall be accomplished as per the manufacturer’s written instructions. Any deviation from the manufacturer’s instructions shall be reviewed and approved by the manufacturer.

F. Piping Restraints:

1. Comply with requirements in MSS SP-127.
4. Seismically restrain piping, with an Ip = 1.0, located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1¼" I.D. and larger.
5. Seismically restrain all other Ip = 1.0 piping 2½" diameter and larger.
6. Seismically restrain all Ip = 1.5 piping larger than 1" diameter.
7. Branch lines may not be used to brace main lines.
8. Exemptions:

    a. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where Ip = 1.0.
    b. High deformability pipe or conduit in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where Ip = 1.5.
    c. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where Ip = 1.5.
    d. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
    e. Piping systems, including their supports, designed and constructed in accordance with ASME B31.
    f. Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7).

G. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.

H. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

I. Where pipe sizes reduce below dimensions required for seismic, the final restraint shall be installed at the transition location.

J. Restraint Spacing For Piping: Sizes shown are maximum. Actual spacing determined by calculation.

1. For non-ductile piping (e.g., cast iron, PVC) space transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
2. For piping with hazardous material inside (e.g., natural gas, medical gas) space Transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
3. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
4. For all other ductile piping see Table "A" below

K. Seismic Restraint of Ductwork: Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints: (Ductwork not meeting criteria listed below is to be "Exempt")

1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Duct with and an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
2. Restrain round ducts with diameters of 28” or larger. Duct with an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
4. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.
5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
6. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
7. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.
8. All ductwork weighing more than 17 lb/ft.
9. Exemptions:

    a. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork. This exemption does not apply to ducts with an importance factor of 1.5.

10. See Table “A” below for restraint spacing.

L. Exemptions do not apply for:

1. Life Safety or High Hazard Components

    a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility’s continued operation, Occupancy Category IV, IBC-2009 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. (A partial list is illustrated.) High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

2. Piping

    a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.

3. Duct

    a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

4. Equipment

a. Previously excluded non life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

M. Spacing Chart For Suspended Components:

Table "A" Seismic Bracing (Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	**On Center Transverse**	**On Center Longitudinal**	**Change Of Direction**
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered Or Grooved			
To 16"	40 Feet	80 Feet	4 Feet
18" – 28"	30 Feet	60 Feet	4 Feet
30" – 40"	20 Feet	60 Feet	4 Feet
42" & Larger	10 Feet	30 Feet	4 Feet

N. Roof mounted duct is to be installed on sleepers or frames mechanically connected to the building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading factors shall be determined by the registered design professional.

O. Where duct sizes reduce below dimensions required for seismic restraint the final restraint shall be installed at the transition location.

P. Install cables so they do not bend across edges of adjacent equipment or building structure.

Q. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

R. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

S. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

T. Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.

U. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

3.7 FIELD QUFALITY CONTROL

A. Testing Agency: Engag**e** a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. A representative of the vibration isolation system manufacturer shall review the project installation and provide documentation indicating conformance to vibration isolation design intent

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

1. The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer’s representative’s final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

3.8 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
1. Adjust active height of spring isolators.

C. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

EQUIPMENT ISOLATION SCHEDULE									
LOCATION	A' CRITICAL (35'-50' SPAN)			B' UPPER STORY (20'-35' SPAN)			C' GRADE		
EQUIPMENT (1)	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE TYPE
AIR HANDLING UNITS									
FLOOR MOUNTED									
UP TO 15 HP	S3	1.5		S3	0.75		S3	0.75	
20 HP & OVER	S3	2.5	SB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75		H3	1		H3	1	
20 HP & OVER	H3	2.5	SB1	H3	1.75		H3	1	
HIGH PRESSURE FAN SECTIONS									
UP TO 30 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
40 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	1.5	IB1
CENTRIFUGAL FANS									
CL. I & II UP TO *54-112"* W.D.									
UPT015HP	S3	1.5	SB1	S3	0.75	SB1	S3	0.75	SB1
20-50 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	SB1
60 HP & OVER	S1	3.5	IB1	S1	2.5	IB1	S3	1.5	SB1
CL. I & II 60" W.D. & OVERI ALL									
CL. III FANS									
UPT015HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
20-50 H P	S1	2.5	IB1	S1	2.5	IB1	S3	1.5	IB1
60 HP & OVER	S1	3.5	IB1	S1	2.5	IB1	S3	1.5	IB1
AXIAL FLOWFANS									
FLOOR MTD.									
UP TO 15 HP	S3	1.5	SB1	S3	0.75		S3	0.75	
20 HP & OVER	S1	3.5	IB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75	SB1	H3	1		H3	1	
20 HP & OVER	H3	2.5	SB1	H3	1.75	SB1	H3	1.5	
VENT (UTILITY SETS)									
FLOOR MTD	S3	1.5	SB1	S3	0.75		S3	0.75	
SUSPENDED	H3	1.75	SB1	H3	1		H3	0.75	
CABINET FANS, FANS SECTIONS									
FLOOR MTD.									
UP TO 15 HP	S3	1.5		S3	0.75		S3	0.75	
20 HP & OVER	S1	2.5	IB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75		H3	1		H3	0.75	
20 HP & OVER	H3	2.5	SB1	H3	1.75		H3	1.75	
PUMPS									
FLOOR MTD.									
UP TO 15 HP	S3	0.75	IB1	S3	0.75	IB1	SRVD	0.4	IB1
7-112 HP & OVER	S3	1.5	IB1	S3	1.5	IB1	S3	0.75	IB1
SUSPENDED INLINE	H3	1.75		H3	1.75		H3	1	

REFRIGERATION UNITS									
RECIPROCATING COMPRESSORS	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
RECIPROCATING COND. UNITS & CHILLERS	S1	2.5	IB1	S3	1.5		S3	0.75	
HERMETIC CENTRIFUGALS	S3	2.5		S3	1.5		P1	0.15	
OPEN CENTRIFUGALS	S1	2.5	IB1	S3	1.5	IB1	P1	0.15	
ABSORPTION MACHINES	S3	1.5		S3	0.75		P1	0.15	
AIR COMPRESSORS									
TANK TYPE (HORIZONTAL TANK)	S1	2.5	IB1	S3	1.5		S3	0.75	
TANK TYPE (VERTICAL TANK)	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
COOLING TOWERS & CLOSED CIRCUIT COOLERS									
UP TO 500 TONS	S3	2.5		S3	0.75		P1	0.15	
OVER 500 TONS	S3	4.5		S3	2.5		P1	0.15	
AIR COOLED CONDENSERS									
UP TO 50 TONS	S3	1.5		S3	0.75		P1	0.15	
OVER 50 TONS	S3	2.5		S3	1.5		P1	0.15	
ROOFTOP AIR CONDITIONING UNITS									
REQUIRING WEATHER SEAL									
UP TO 5000 CFM (12 TON)	S1	1.5	RC1	S1	0.75	RC1			
OVER 5000 CFM (12 TON)	S3	2.5	RC1	S3	1.5	RC1			
OTHER TYPES									
UP TO 25 TONS	S3	1.5		S3	1.5				
OVER 25 TONS	S3	2.5		S3	1.5				
BOILER (PACKAGE TYPE)									
ALL SIZES	S3	1.5		S3	0.75		P1	0.15	
ENGINE DRIVEN GENERATORS									
UP TO 60 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
75 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	0.75	

NOTES:

1) Thrust restraints required on all high-pressure fan section, suspended axial-flow fans and on floor-mounted axial fans operating at 3.0" S.P. or greater.

END OF SECTION 230548

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SECTION 230550

OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All pertinent sections of Division 21, 22, & 23 Mechanical General Requirements, are part of the work of this Section. Division 1 is part of this and all other sections of these specifications.

1. Testing and Balancing is specified in section 230594.
2. Training and Instructions to Owner's Representative is specified in section 230100.

1.2 SCOPE OF WORK

A. Submission of Operating and Maintenance Manuals complete with Balancing reports. (Coordinate with Division 1).

B. Coordination of work required for system commissioning.

C. Provide a hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format.

1.3 SUBMITTALS

A. Submit product data in accordance with Division 1 and Section 230100. Submit the following:

1. Sample of O and M manual outline.
2. Hard copy and an electronic copy on CD of the O and M manual fully searchable in PDF format. Both the hard copy and the electronic copy are to be fully indexed. The electronic copy shall also have a linked index.

PART 2 - PRODUCTS

2.1 O & M MANUALS

A. The operating and maintenance manuals shall be as follows:

1. Binders shall be red buckram with easy-view metal for size 8-1/2 x 11-inch sheets, with capacity expandable from 2 inches to 3-1/2 inches as required for the project. Construction shall be rivet-through with library corners. No. 12 backbone and lining shall be the same material as the cover. The front cover and backbone shall be foil-stamped in white as follows: (coordinate with **Division 01**)

OPERATING AND MAINTENANCE
MANUAL
FOR THE

(INSERT PROJECT NAME)

(INSERT PROJECT COMPLETION YEAR)

VOLUME No. ( )

VAN BOERUM & FRANK ASSOCIATES, INC.
MECHANICAL ENGINEER

(INSERT ARCHITECT)

PART 3 - EXECUTION

3.1 OPERATING AND MAINTENANCE MANUALS:

A. Work under this section shall be performed in concert with the contractor performing the system testing and balancing. Six (6) copies of the manuals shall be furnished to the Architect for distribution to the owner.

B. The "Start-Up and Operation" section is one of the most important in the manual. Information in this section shall be complete and accurately written and shall be verified with the actual equipment on the job, such as switches, starters, relays, automatic controls, etc. A step-by-step start-up procedure shall be described.

C. The manuals shall include air and water-balancing reports, system commissioning procedures, start-up tests and reports, equipment and system performance test reports, warranties, and certificates of training given to the owner’s representatives.

An index sheet typed on AICO Gold-Line indexes shall be provided in the front of the binder. The manual shall be include the following:

SYSTEM DESCRIPTIONS

START-UP PROCEDURE AND OPERATION OF SYSTEM

MAINTENANCE AND LUBRICATION TABLE

OPERATION AND MAINTENANCE BULLETINS

AUTOMATIC TEMPERATURE CONTROL DESCRIPTION OF OPERATION, INTERLOCK AND CONTROL DIAGRAMS, AND CONTROL PANELS.

AIR AND WATER SYSTEM BALANCING REPORTS

EQUIPMENT WARRANTIES AND TRAINING CERTIFICATES

SYSTEM COMMISSIONING REPORTS

EQUIPMENT START-UP CERTIFICATES

END OF SECTION 230550

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Danger, Warning and Caution signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Danger tags.
8. Warning tags.
9. Caution tags.
10. Ceiling grid.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Minimum Thickness, predrilled or stamped holes for attachment hardware:
   a. Brass, 0.032-inch .
2. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2** by **3/4 inch**.
3. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less **than 24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel;
   a. Rivets or self-tapping screws
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware, **1/16 inch** thick.

2. Letter Color:
   a. Black.
3. Background Color:
   a. White.
4. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
6. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches, 1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel;
   a. Rivets or self-tapping screws
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 DANGER, WARNING AND CAUTION SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; **1/16 inch** thick.

B. Danger signs, colors:
   1. Letter Color:
      a. White.
   2. Background Color:
      a. Red.

C. Warning signs, colors:
   1. Letter Color:
      a. Black.
   2. Background Color:
      a. Orange.

D. Caution signs, colors:
   1. Letter Color:
      a. Black.
   2. Background Color:
      a. Yellow.

E. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.

F. Minimum Label Size: Length and width vary for required label content, but not less **than 2-1/2 by 3/4 inch**.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

H. Fasteners: Stainless-steel;
   1. Rivets or self-tapping screws
   2. Rivets.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **partially cover** circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 incheshigh.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; **1/16 inch** thick.

B. Letter Color:
1. White.

C. Background Color:
1. Black.

D. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.

E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.

F. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel;
1. Rivets or self-tapping screws

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least **1-1/2 inches** high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of **1-1/4 inches** for ducts; and minimum letter height of **3/4 inch** for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material:
a. Aluminum .
2. Stencil Paint:
a. Exterior, gloss, **alkyd enamel** black unless otherwise indicated.
b. Paint may be in pressurized spray-can form.
3. Identification Paint:
a. Exterior, **alkyd enamel** in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material, predrilled or stamped holes for attachment hardware, minimum thickness:
   a. Brass, 0.032-inch
2. Fasteners: Brass;
   a. Wire-link or beaded chain; or S-hook

B. Valve Schedules:

1. For each piping system, on **8-1/2-by-11-inch** bond paper, tabulate;
   a. Valve number.
   b. Piping system.
   c. System abbreviation (as shown on valve tag).
   d. Location of valve (room or space).
   e. Normal-operating position (open, closed, or modulating).
   f. Variations for identification.
   g. Mark valves for emergency shutoff and similar special uses.
2. Valve-tag schedule:
   a. Shall be included in operation and maintenance data.

2.7 DANGER TAGS

A. Danger Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size:
   a. 3 by 5-1/4 inches minimum
2. Fasteners:
   a. Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," and "DO NOT OPERATE."
4. Color: Red background with white lettering.

2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size:
   a. 3 by 5-1/4 inches minimum
2. Fasteners:
   a. Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as “WARNING” and "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

2.9 CAUTION TAGS

A. Caution Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size:
   a. 3 by 5-1/4 inches minimum

2. Fasteners:
   a. Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "CAUTION," and "DO NOT OPERATE."
4. Color: Orange background with black lettering.

2.10 CEILING GRID

A. Provide red lettering on the ceiling tile grid of the locations of all fire dampers, smoke dampers and fire/smoke dampers. Size of lettering and verbiage is to conform to IBC and NFPA standards.

B. Provide valve identification for all HVAC valves located above the ceiling on the ceiling grid below the valve.

C. Provide VAV box identification for all VAV boxes located above the ceiling on the ceiling grid below the VAV box.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in **Division 09**.

B. Stenciled Pipe Label Option:

1. Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option.
2. Install stenciled pipe labels **with painted, color-coded bands or rectangles** on each piping system.
   a. Identification Paint: Use for contrasting background.
   b. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of **50 feet** along each run. Reduce intervals to **25 feet** in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule: (See Drawing Schedules)

3.4 DUCT LABEL INSTALLATION

A. Install **plastic-laminated** duct labels with permanent adhesive on air ducts in the following color codes:

1. **Blue** : For cold-air supply ducts.
2. **Yellow** : For hot-air supply ducts.
3. **Green** : For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of **50 feet** in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION (See Drawing Schedules.)

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Primary-secondary hydronic systems.

3. Various HVAC Equipment.

    a. Heat Exchangers.
    b. Motors.
    c. Condensing Units.
    d. Boilers.
    e. Heat Transfer Coils.

4. Domestic Heater Systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within the following number of days of the Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article;
   1. 30 days.

B. Certified TAB reports.

C. Instrument calibration reports, to include the following:

   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by **AABC** or **NEBB**.

   1. TAB Field Supervisor: Employee of the TAB contractor and certified by **AABC** or **NEBB** and shall be the same as the TAB Contractor.
   2. TAB Technician: Employee of the TAB contractor and who is certified by **AABC** or **NEBB** as a TAB technician and shall be the same as the TAB Contractor.

B. Certify TAB field data reports and perform the following:

   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by:
   1. Architect .

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide [**seven**] days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on the following distribution systems have been satisfactorily completed:

1. **Air .**
2. **Water .**
3. **Air and water .**

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, **engage one of the following**:

1. Bonneville Test and Balance
2. BTC Service.
3. Certified Test & Balance.
4. Diamond Test & Balance.
5. RS Analysis.
6. Test & Balance Inc.
7. Payson Sheetmetal.
8. QT&B Inc.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine:
1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
   a. Section 233113 "Metal Ducts"
2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
3. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment

performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in this section and:

1. AABC's "National Standards for Total System Balance"

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in **inch-pound (IP)** .

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from one of the following entities for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance:
   a. Architect .
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Section 232123 "Hydronic Pumps.":
        1) Architect.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

    a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.12 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.13 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.14 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.17 DOMESTIC HEATER SYSTEMS

A. Test domestic heater system per Engineer's instructions.

3.18 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: **Plus or minus 10 percent .**
2. Air Outlets and Inlets: **Plus or minus 10 percent .**
3. Heating-Water Flow Rate: **Plus or minus 10 percent .**
4. Cooling-Water Flow Rate: **Plus or minus 10 percent .**

3.19 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare progress reports on the following interval to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors;

1. Weekly.

3.20 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.

4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total air flow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Filter static-pressure differential in inches wg.
    f. Preheat-coil static-pressure differential in inches wg.
    g. Cooling-coil static-pressure differential in inches wg.
    h. Heating-coil static-pressure differential in inches wg.
    i. Outdoor airflow in cfm.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch o.c.
    f. Make and model number.
    g. Face area in sq. ft..
    h. Tube size in NPS.
    i. Tube and fin materials.
    j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm.
    b. Average face velocity in fpm.
    c. Air pressure drop in inches wg.
    d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    e. Return-air, wet- and dry-bulb temperatures in deg F.
    f. Entering-air, wet- and dry-bulb temperatures in deg F.
    g. Leaving-air, wet- and dry-bulb temperatures in deg F.
    h. Water flow rate in gpm.
    i. Water pressure differential in feet of head or psig.
    j. Entering-water temperature in deg F.
    k. Leaving-water temperature in deg F.
    l. Refrigerant expansion valve and refrigerant types.
    m. Refrigerant suction pressure in psig.
    n. Refrigerant suction temperature in deg F.

o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Air flow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

    a. Heat output in Btu/h.
    b. Air flow rate in cfm.
    c. Air velocity in fpm.
    d. Entering-air temperature in deg F.
    e. Leaving-air temperature in deg F.
    f. Voltage at each connection.
    g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches, and bore.
    h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft..
    g. Indicated air flow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual air flow rate in cfm.

j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.

e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

N. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.21 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least **10** percent of air outlets.
b. Measure water flow of at least **5** percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by:
   a. Architect .
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of:
   a. Architect .
3. The following entity shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day:
   a. Architect .
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.22 ADDITIONAL TESTS

A. Within **90 days** of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of **25** or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of **75** or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, **Type III with factory-applied FSK jacket**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; SOFTR All-Service Duct Wrap.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation **with factory-applied ASJ**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; Commercial Board.
    b. Fibrex Insulations Inc.; FBX.
    c. Johns Manville; 800 Series Spin-Glas.
    d. Knauf Insulation; Insulation Board.
    e. Manson Insulation Inc.; AK Board.
    f. Owens Corning; Fiberglas 700 Series.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to **1700 deg F**. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a:
a. 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction

1. Products: Subject to compliance with requirements, provide the following :

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a:
a. **2**-hour fire rating by an NRTL acceptable to authorities

1. Products: Subject to compliance with requirements, provide one of the following :

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. FSK Jacket Adhesive, and ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, **provide one of the following**:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of **50** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** at **43-mil** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F**.
4. Solids Content: ASTM D 1644, **58 percent** by volume and **70 percent** by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** at **0.0625-inch** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F**.
4. Solids Content: **60 percent** by volume and **66 percent** by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of **50** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: **0 to plus 180 deg F**.
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F**.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of **420** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with **ASTM B 209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. **Sheet and roll stock ready for shop or field sizing**
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: **3-mil-thick, heat-bonded polyethylene and kraft paper**.
d. Moisture Barrier for Outdoor Applications: **3-mil-thick, heat-bonded polyethylene and kraft**.

2.9 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: **3 inches**.
3. Thickness: **6.5 mils**.
4. Adhesion: **90 ounces force/inch** in width.
5. Elongation: **2** percent.
6. Tensile Strength: **40 lbf/inch** in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.

2. Width: **2 inches**.
3. Thickness: **3.7 mils**.
4. Adhesion: **100 ounces force/inch** in width.
5. Elongation: **5** percent.
6. Tensile Strength: **34 lbf/inch** in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Aluminum: **ASTM B 209**, Alloy 3003, 3005, 3105, or 5005; Temper H-14, **0.020 inch** thick, **3/4 inch** wide with **wing seal**.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.135-inch-**diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **0.135-inch-** diameter shank, length to suit depth of insulation indicated with integral **1-1/2-inch** galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
   c. Spindle: **Copper- or zinc-coated, low-carbon steel** fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   b. Baseplate: Perforated, nylon sheet, **0.030 inch** thick by **1-1/2 inches** in diameter.
   c. Spindle: Nylon, **0.106-inch-** diameter shank, length to suit depth of insulation indicated, up to **2-1/2 inches**.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.

   b. Baseplate: Galvanized carbon-steel sheet, **0.030 inch** thick by **2 inches** square.
   c. Spindle: **Copper- or zinc-coated, low-carbon steel**, fully annealed, **0.106-inch-** diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches** o.c.
3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
   a. **2 inche** o.c.
   b. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least **2 inches**.

1. Comply with requirements in Section 078413 "Penetration Firestopping" firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least **2 inches**.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for:
   a. **100** percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
   b. On duct sides with dimensions larger than **18 inches**, place pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment.

Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below **50 deg F** at **18-foot** intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than **3 inches**.

5. Overlap unfaced blankets a minimum of **2 inches** on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of **18 inches** o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch-**wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for:
   a. 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions **18 inches** and smaller, place pins along longitudinal centerline of duct. Space **3 inches** maximum from insulation end joints, and **16 inches** o.c.
   b. On duct sides with dimensions larger than **18 inches**, space pins **16 inches** o.c. each way, and **3 inches** maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing **2 inches** from one edge and one end of insulation segment. Secure laps to adjacent insulation section with **1/2-inch** outward-clinching staples, **1 inch** o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with **6-inch-** wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced **6 inches** o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with **2-inch** overlap at seams and joints.
2. Embed glass cloth between two **0.062-inch-** thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with **1-1/2-inch** laps at longitudinal seams and **3-inch-** wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches** o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: **Two** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency:
a. Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to **one** location for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.

2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 Insulation shall have an R value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.13 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. All supply and return ducts and plenums shall be insulated with not less than R-6 insulation.

B. Concealed, round and flat-oval, supply-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

C. Concealed, round and flat-oval, return-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

D. Concealed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

E. Concealed, round and flat-oval, exhaust-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

F. Concealed, rectangular, supply-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

G. Concealed, rectangular, return-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

H. Concealed, rectangular, outdoor-air and combustion-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation:

a. Fire-rated **blanket**; thickness as required to achieve 2-hour fire rating.

1. Ductwork is to be wrapped with two layers of approved fire wrap that meets ASTM E-2336.

J. Concealed, supply-air plenum insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

K. Concealed, return-air plenum insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

L. Concealed, outdoor-air plenum insulation shall be **one of** the following:

1. Flexible Elastomeric: **1-1/2 inch** thick.
2. Mineral-Fiber Blanket: **2 inches** thick and **0.75-lb/cu. ft.** nominal density.

M. Exposed, round and flat-oval, supply-air duct insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.
2. Double Wall Duct per specification section 233113.

N. Exposed, round and flat-oval, return-air duct insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.
2. Double Wall Duct per specification section 233113.

O. Exposed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.

P. Exposed, rectangular, supply-air duct insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.
2. Double Wall Duct per specification section 233113.

Q. Exposed, rectangular, return-air duct insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.
2. Double Wall Duct per specification section 233113.

R. Exposed, rectangular, outdoor-air and combustion-air duct insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.

S. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation:

a. Fire-rated **blanket**; thickness as required to achieve 2-hour fire rating.

T. Exposed, supply-air plenum insulation shall be[**one of**] the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.

U. Exposed, return-air plenum insulation shall be **one of** the following:

1. Fibrous Glass Duct Liner: **1-1/2 inch** thick.

V. **All medium pressure ductwork from the air handler to 20 feet down stream of the air handler shall be double wall ductwork with 2" thick insulation and inner duct as specified in the double-wall duct specifications**.

END OF SECTION 230713

SECTION 23 0719

HVAC Piping Insulation

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping.
2. Chilled-water piping.
3. Canal-water piping.
4. Heating hot-water piping.
5. Refrigerant suction and hot-gas piping.

1.3 DEFINITIONS:

A. Refer to Section 230500 “Common Work Results for HVAC”.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Insulation for below-ambient service requires a vapor-barrier.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide the following:

    a. Industrial Insulation Group (IIG); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553,
1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

J. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000-Degree Pipe Insulation.
c. Manson Insulation Inc.; Alley-K.
d. Owens Corning; Fiberglas Pipe Insulation.
e. Type I, **850 deg F** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, **Type I, Grade A:**
1) with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied:
1. **ASJ** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft.** or more. Thermal conductivity (k-value) at **100 deg F** is **0.29 Btu x in./h x sq. ft. x deg F** or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

L. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F**.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
   b. Eagle Bridges - Marathon Industries; 290.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
   d. Mon-Eco Industries, Inc.; 22-30.
   e. Vimasco Corporation; 760.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Aeroflex USA, Inc.; Aeroseal.
   b. Armacell LLC; Armaflex 520 Adhesive.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
   d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
   d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 739, Dow Silicone.
   b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.
   d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** at **43-mil** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F**.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
   b. Eagle Bridges - Marathon Industries; 570.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** at **30-mil** dry film thickness.
3. Service Temperature Range: **Minus 50 to plus 220 deg F**.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    b. Eagle Bridges - Marathon Industries; 550.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    d. Mon-Eco Industries, Inc.; 55-50.
    e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** at **0.0625-inch** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F**.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: **Minus 40 to plus 250 deg F**.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
    1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Color-code jackets based on system:
   a. White
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, **provide one of the following**:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with **ASTM B 209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications:
      1) **1-mil-** thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications:
      1) **3-mil-** thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: **3 inches**.
3. Thickness: **11.5 mils**.

4. Adhesion: **90 ounces force/inch** in width.
5. Elongation: 2 percent.
6. Tensile Strength: **40 lbf/inch** in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. ABI, Ideal Tape Division; 370 White PVC tape.
   b. Compac Corporation; 130.
   c. Venture Tape; 1506 CW NS.

2. Width: **2 inches**.
3. Thickness: **6 mils**.
4. Adhesion: **64 ounces force/inch** in width.
5. Elongation: 500 percent.
6. Tensile Strength: **18 lbf/inch** in width.

2.9 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches** o.c.
3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at
   a. **2 inches o.c.**
   b. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least **2 inches** below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least **2 inches**.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape

insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at **12-inch** intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches**. Secure inner layer with wire spaced at **12-inch** intervals. Secure outer layer with stainless-steel bands at **12-inch** intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least **1 inch**. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.

3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches** o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches** o.c. and at end joints.

3.10 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: **Two** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 **Insulation shall have a k value that meets the minimum requirements of the latest International** Energy Conservation Code (IECC).

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below **60 Deg F**:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric:
      1) **1/2 inch** thick
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      1) **1/2 inch** thick

B. Chilled Water, **40 Deg F** and below:

1. NPS **1-1/2 inch** and Smaller: Insulation shall be the following:
   a. Flexible Elastomeric:
      1) **1-1/2 inch** thick.

2. NPS **2 inch** and Larger: Insulation shall be the following:
   a. Flexible Elastomeric:
      1) 1-1/2 inch thick.

3. Insulation for runouts not exceeding 48 inches in length for connection to equipment shall be the following:

   a. Flexible Elastomeric: **1 inch** thick.

C. Chilled Water, above **40 Deg F**:

1. NPS **1-1/2 inch** and Smaller: Insulation shall be one of the following:
   a. Flexible Elastomeric:
      1) **1-1/2 inch** thick.
   b. Mineral-Fiber, Preformed Pipe, Type I:
      1) **1-1/2 inches** thick.

2. NPS **2 inch** and Larger: Insulation shall be one of the following:
   a. Flexible Elastomeric:
      1) **1-1/2 inch** thick.
   b. Mineral-Fiber, Preformed Pipe, Type I:
      1) **1-1/2 inches** thick.

3. Insulation runouts not exceeding **48 inches** in length for connection to equipment shall be one of the following:

   a. Flexible Elastomeric: **1 inch** thick.
   b. Mineral-Fiber, Preformed Pipe, Type I: **1 inch** thick

4. Condenser-water supply and return piping located indoors and operating in range of 55 to 105 deg F (13 to 41 deg C) is not always insulated. If condenser-water system operates as part of a water-side economizer cycle or if Project requires condensation control, piping should be insulated.

D. Canal-Water Supply and Return:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: **1 inch** thick.
   b. Mineral-Fiber, Preformed Pipe, Type I:
      1) **1 inch** thick

E. Heating-Hot-Water Supply and Return, **200 Deg F** and Below:

1. **NPS 1 1/2** and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I:
      1) 1-1/2 inch thick

2. Greater than **NPS 1-1/2 inch** : Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation:
      1) **2 inches** thick

3. Insulation for runouts not exceeding **48 inches** in length for connection to equipment shall be the following:

   a. Mineral-Fiber, Preformed Pipe, Type I: **1 inch** thick.

F. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be **one of** the following:
   a. Flexible Elastomeric: **1 inch** thick.

G. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: **1 inch** thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:
1. **PVC:**
   a. White: **30 mils** thick.

END OF SECTION 230719

23 0900

BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Facility Management and Control System (FMCS) Contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control as herein specified. The system shall include all required computer software and licenses, hardware, controllers, sensors, transmission equipment, system workstations, local panels, conduit, wire, installation, engineering, database and setup, supervision, commissioning, acceptance test, training, warranty service and, at the owner's option, extended warranty service. Licenses for all software shall be registered to the owner. Include all upgrades for a period of two years.

B. The system shall only employ BACnet or Lontalk communications in an open architecture with the capabilities to support a multi-vendor environment. The software package shall be sold and promoted by at least three independent controls manufacturers. It shall include the provisions to load and execute the toolsets of each of the three manufacturers including commissioning, configuring and programming of each manufacturer's equipment. The system shall be capable of integrating third party systems and utilizing the following standard protocols.

1. BACnet communication according to ASHRAE standard ANSI/ASHRAE 135-2004.
2. OPC server communications according to OPC Data Access 2.0 and Alarms and Events 1.0.
3. LonWorks communication using LonTalk protocol.
4. Modbus communication for integration to third party devices.

C. The FMCS shall be web based and shall provide total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.

D. The FMCS shall demonstrate, with (3) proof sources, integration with HVAC industry open standard protocols, including LonMark, BACnet, ModBus, OPC and Internet standard SQL database and HTTP / HTML / XML text formats.

E. The FMCS shall communicate to third party systems on this project including VFD's, boilers, air handling systems, chillers, fuel systems, air compressor, computer room units, transfer switches, fire-life safety systems and other building management related devices using any of the open, interoperable communication protocols referenced in Paragraph D.

F. All materials and equipment used shall be standard components, regularly manufactured with standard part numbers and owners manuals for this and/or other systems. One of a kind, third party or custom integrations devices designed specially for this project will not be allowed.

1.2 SYSTEM DESCRIPTION

A. The Building Management and Control System (BMCS) shall be comprised of Network Area Controller or Controllers (BMS) within the facility. The BMS shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network.

1.3 SUBMITTAL

A. Four copies or PDF of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package. Specification contractors supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists for proper coordination of work.

B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.

C. Submittal shall also include a complete point list of all points to be connected to the BMCS.

D. Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on review comments from the A/E design team and/or Owner.

E. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ or Visio™ compatible files. Four copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk or USB flash drive. All as built drawings shall also be installed into the BMCS server in a dedicated directory.

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

BMCS	Building Management and Control System
TCS	Temperature Control System
BMS	Building Management Server
NAC	Network Area Controller
IDC	Interoperable Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
PMI	Power Measurement Interface

DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

1.5 DIVISION OF WORK

A. The specified contractors shall be responsible for all controllers (NAC, IDC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring.

B. The specified contractor shall be responsible for the Network Area Controller(s) (BMS), software and programming of the BMS, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, BACnet or LonWorks network management and connection of the BMS to the local or wide area network.

C. Provide support for the Balancing Contractor.

1.6 AGENCY AND CODE APPROVALS

A. All products of the TCS and BMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

1. UL-916; Energy Management Systems
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “signal Equipment”
3. CE
4. FCC, Part 15, Subpart J, Class A Computing Devices

1.7 SOFTWARE LICENSE AGREEMENT

A. The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the BMS, BMCS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall determine which organizations to be named in the SI organization ID (“orgid”) of all software licenses. Owner shall be free to direct the modification of the “orgid” in any software license, regardless of supplier.

1.8 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

PART 2 - MATERIALS

2.1 GENERAL

A. The Temperature Control System (TCS) and Building Management Control System (BMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system (Server provided by Customer), graphical user interface software, network devices, valves, dampers, sensors, and other devices as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMCS.

2.2 PRE-APPROVED INTALLERS

A. Johnson Controls by the local Johnson Controls branch office

B. Johnson Controls by CCI

2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2004 BACnet, LonWorks technology, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied Supervisor software with a 5-year Software Maintenance Agreement (SMA) shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2004, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

C. All components and controllers supplied under this Specification shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.4 NETWORK AREA CONTROLLER (NAC)

A. The Network Area Controller (NAC) shall provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data
7. Integration of BACnet and MODBUS networks

B. The NAC shall provide multiple, concurrent user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

C. The NAC shall support standard Web browser access via the Intranet/Internet. It shall be capable of supporting multiple users, expandable to fifty.

D. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

1. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
2. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:

a. To alarm

b. Return to normal
c. To fault

3. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
4. Provide timed (schedule) routing of alarms by class, object, group, or node.
5. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

E. Alarms shall be annunciated in any of the following manners as user defined:

1. Screen message text
2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

a. Day of week
b. Time of day
c. Recipient

3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer
6. Cell phones

F. The following shall be recorded by the NAC for each alarm (at a minimum):

1. Time and date
2. Location (building, floor, zone, office number, etc.)
3. Equipment (air handler #, accessway, etc.)
4. Acknowledge time, date, and user who issued acknowledgement.

G. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

H. A log of all alarms shall be maintained by the NAC and/or a server and shall be available for review by the user.

I. Provide a “query” feature to allow review of specific alarms by user defined parameters.

J. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

K. An Error Log to record system errors shall be provided and available for review by the user.

L. Data Collection and Storage

1. The NAC shall collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

a. Designating the log as interval or deviation.
b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a standard Web Browser.
4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
5. All log data shall be available to the user in the following data formats:

    a. HTML
    b. XML
    c. Plain Text
    d. Comma or tab separated values

6. The NAC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:

    a. Archive on time of day
    b. Archive on user-defined number of data stores in the buffer (size)
    c. Archive when buffer has reached it's user-defined capacity

M. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

N. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time of day.

1. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
2. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

1.2 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)

A. Programmable Equipment Controllers (PEC's) shall be stand-alone, multi-tasking, real-time digital control processors.

B. The PEC's shall communicate via BACnet communication according to ASHRAE standard ANSI/ASHRAE 135-2004 or Lonworks FT110.

C. The PEC must communicate peer-to-peer with all of the network application specific, programmable controllers and third party LonMark devices.

D. The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.

E. Provide programming, engineering, and configuration tools used for the project duly licensed to the owner for owner's use.

F. PEC's shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

G. A single process shall be able to incorporate measured or calculated data from any and all other PEC's on the network. In addition, a single process shall be able to issue commands to points in any and all other PEC's on the network.

H. Each PEC shall support firmware upgrades without the need to replace hardware.

I. Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components.

J. In the event of the loss of normal power, there shall be an orderly shutdown of all PEC's to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.
2. All PEC's control programming and databases must be stored in Flash memory, therefore eliminating data loss, downtime and re-load time.

K. Provide a separate PEC for each AHU or other HVAC system such that the inputs, calculations, and outputs shall reside on a single controller.

1.3 APPLICATION SPECIFIC CONTROLLERS (ASC)

A. Each Application Specific Controller (ASC) shall operate as a stand-alone Lon Mark or BacNet controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.

B. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power.

C. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.

D. The control program shall reside in the ASC. The application program and the configuration information shall be stored in non-volatile memory with no battery back-up required.

E. After a power failure the ASC must run the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.

2.5 DATA COLLECTION AND STORAGE

A. The BMS shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the BMS that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the BMS and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.

D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:

1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values

F. The BMS shall have the ability to archive its log data.

1. Archive on time of day
2. Archive on user-defined number of data stores in the log (buffer size)
3. Archive when log has reached its user-defined capacity of data stores
4. Provide ability to clear logs once archived

G. **Histories and Trending.**

1. **Histories shall include all Input and Output devices and their associated control points i.e. Setpoints.**
2. **Trending shall be able to be displayed in Dashboards, charts, or graphs.**

2.6 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the BMS. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the BMS), to another BMS on the network, or to a server. For each log entry, provide the following data:

1. Time and date
2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.7 INTEROPERABLE DIGITAL CONTROLLER (IDC)

A. Controls shall be the latest Honeywell Niagara N4 microprocessor based Interoperable LonWorks Controllers (IDC) with add on I/O modules or using Unitary Controller architecture. Where possible, all Interoperable Digital Controllers shall bear the applicable LonMark™ interoperability logo on each product delivered.

B. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark profile defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device. Publicly available specifications for the Applications Programming Interface (API) must be provided for each LonWorks / LonMark controller defining the programming or setup of each device. The contractor shall provide all programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation.

C. The Specified contractor shall run the LonWorks or BACnet network trunk to the nearest Network Area Controller (NAC). Coordinate locations of the BMS to ensure that maximum network wiring distances, as specified by the LonWorks wiring guidelines, are not exceeded. A maximum of 126 devices may occupy any one LonWorks trunk and must be installed using the appropriate trunk termination device. All LonWorks and LonMark devices must be supplied using FTT-10A LonWorks communications transceivers.

D. The Network Area Controller (NAC) will provide all scheduling, alarming, trending, and network management for the LonMark / LonWorks or BACnet based devices.

E. The IDCs shall communicate with the BMS at a baud rate of not less than 78.8K baud. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

F. All IDCs shall be fully application programmable and shall at all times maintain their LONMARK certification, if so certified. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Provide 10% capacity spare points on al control points.

G. The Specified contractor supplying the IDCs shall provide documentation for each device, with the following information at a minimum:
   1. Network Variable Inputs (nvi's); name and type
   2. Network Variable Outputs (nvo's); name and type
   3. Network configuration parameters (nci, nco); name and type

H. It is the responsibility of the Specified contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each IDC, as required by the point charts.

2.8 GRAPHICAL USER INTERFACE SOFTWARE

A. Command of points from multiple manufacturers shall be transparent to the operator.

B. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows XP 32-bit operating system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line FMCS alarms and monitoring information. If the software is unable to display several different types of displays at the same time, the FMCS contractor shall provide at least two operator workstations at each location specified.

C. Real-Time Displays. The Graphical User Interface (GUI), shall at a minimum, support the following graphical features and functions:

   1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures and streaming video.
   2. Provide programming, engineering, and configuration tools used for the project duly licensed to the owner for owner's use.
   3. A gallery of HVAC and automation symbols shall be provided, including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.
   4. Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
   5. Graphics shall include layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
   6. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

      a. Schedule times will be adjusted by mouse command using a graphical slider, without requiring any keyboard entry from the operator.
      b. Holidays shall be set by mouse command using a graphical calendar, without requiring any keyboard entry from the operator.

7. Commands to start and stop binary objects shall be done by mouse command from the pop-up menu. No entry of text shall be required.

D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select points to be alarmable and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

G. All graphic displays shall be provided using web browser client.

H. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

I. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable. The alarm console shall be loaded and operated at the following locations.

2.9 SYSTEM PROGRAMMING

A. Programmer shall use the latest version of the Workbench or equivalent programming tool.

2.10 FIELD DEVICES

A. Provide automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer.

B. Temperature Sensors

1. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application.
2. Space (room) sensors shall be available with setpoint adjustment and override switch.
3. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches.
4. Sunshields shall be provided for outside air sensors.
5. Thermo-wells for all immersion sensors shall be stainless steel or brass as required for the application.

C. Humidity Sensors: Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Room humidity sensors shall have a minimum range of 10% to 90% ±5%. Supply air humidity sensors shall have a range of 10% to 90% ± 5%.

D. Pressure Sensors: The differential pressure sensor shall be temperature compensated and shall vary the output voltage with a change in differential pressure. Sensing range shall be suitable for the application with linearity of 1.5% of full scale and offset of less than 1% of full scale. Sensor shall be capable of withstanding up to 150% of rated pressure without damage.

E. Flat plate (flush mount) temperature sensors shall be installed in public corridors, behavior health and any other locations where gurneys and/or carts could damage sensors and where public access of setpoint is not desired.

F. Switches and Thermostats

1. The FMCS Contractor shall furnish all electric relays and coordinate with the supplier of magnetic starters for auxiliary contact requirements. All electric control devices shall be of a type to meet current, voltage, and switching requirement of their particular application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10 amps minimum.
2. Duct Smoke Detectors: Duct smoke detectors shall be supplied by others with an integral auxiliary contact to be used by the FMCS contractor to provide a digital input to the FMCS.
3. Low Temperature Detection Thermostats: Shall be the manual reset type. The thermostat shall operate in response to the coldest one-foot length of the 20-foot sensing element, regardless of the temperatures at other parts of the element. The element shall be properly supported to cover the entire downstream side of the coil with a minimum of three loops. Separate thermostats shall be provided for each 25 square feet of coil face area or fraction thereof.
4. Differential Pressure Switches: Pressure differential switches shall have SPDT changeover contact, switching at an adjustable differential pressure setpoint.
5. Current Sensing Relays: Motor status indications, where shown on the plans, shall be provided via current sensing relays. The switch output contact shall be rated for 30 VDC, .15 amps.

6. Flow Switches: Motor status indications, where shown on the plans, shall be provided via flow switches. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow.
7. Carbon Monoxide Detector and Controller shall meet or exceed UL 2034 standard and OSHA standards for CO exposure. Controller shall be solid state sensor. Fan relay shall activate at 35 ppm of CO averaged over 5 minutes. Alarm relay shall activate at 100 ppm after 30 minutes. Approved manufacturers shall be Macurco, Inc or approved equal.

G. OSA Air Flow Measurement and Air Handler

1. The monitor/controller shall be capable of direct measurement of airflow through an outside air inlet and produce dual outputs; one representing the measured airflow, and the other to control the inlet damper.
2. The monitor/controller shall contain an integral multi-line liquid crystal display for use during the configuration and calibration processes, and to display two measured processes (volume, velocity, temperature) during normal operation. All configuration, output scaling, calibration, and controller tuning will be performed digitally in the on-board microprocessor via input pushbuttons.
3. The monitor/controller shall measure inlet airflow with an accuracy of + or – 5% of reading over a range of 150-600 FPM or 250-1000 FPM or 500-3000 fpm and not have its reading affected by the presence of directional or gusting wind or turbulence. Measured airflow shall be density corrected for ambient temperature variances, and atmospheric pressure due to site altitude.
4. The monitor/controller shall interface with existing building automation systems (BAS), accepting inputs for fan system start, economizer mode operation, and an external controller set point, and provide flow deviation alarm outputs.
5. The sensors shall be constructed of materials that resist corrosion due to the presence of salt or chemicals in the air; all non-painted surfaces shall be constructed of stainless steel. The electronics enclosure shall be NEMA 1.
6. The monitor/controller shall be the VOLU-flo/OAM as manufactured by Air Monitor Corporation, Santa Rosa, California.

H. Supply Air and Return Air Monitoring

1. Provide supply air and return air flow monitoring. The monitor/controller shall be the Veltron DPT 2500 Plus as manufactured by Air Monitor Corporation, Santa Rosa, California. ¼% Accurate, Automatic Zero, has display.
2. Provide Valupress/FI on fan inlets on supply air and return air.

I. Control Valves

1. General: Control Valves up to 4 inches shall be globe valves and shall be sized for a 3 to 5 psi pressure drop. Valves shall be packless, modulating, electrically or magnetically actuated, with a control rangeability of 100 to 1. These valves shall have equal percentage flow characteristics in relationship to valve opening.
2. ½ inch to 4 inch: Valves shall be equipped with handwheel, or manual position mounted dial adjacent to valve, to allow manual positioning of valve in absence of control power. (Valves with a rangeability of less than 200 to 1 shall utilize two valves in a 1/3 – 2/3 parallel arrangement in order to achieve control rangeability).
3. 4 inches to 6 inches: Valves for heating shall be globe valves modulating electrically actuated, 2-way or 3-way as required, with a rangeability of 50 to 1. Valve body shall be flanged and shall be equipped with a handwheel, or manual position dial mounted adjacent to the valve, to allow manual positioning of the valve in the absence of control power. Valves for cooling shall be butterfly with a rangeability of 25 to 1.

4. Butterfly Valves: 2-way and 3-way butterfly valves shall be cast iron valve body, with stainless steel stem, and available with disc seal for bubble-tight shut off.
5. Steam Valves: Valves shall have an ANSI Class 250 lb. body, teflon v-ring packing rated to 377ºF., stainless steel trim rated to 50 psi, with rangeability greater than 100:1, Class 4 leakage and close off rating, linear flow characteristics, via perforated throttling cylinder.

J. Damper Actuators

1. Actuators shall be of the push-pull or rotary type of modulating, 3-point floating, or 2-position control as required by the application. The actuator shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control voltage shall be 24 VAC, 0-20 VDC, or 4-20 ma as required. Actuators shall be available with spring return to the normal position when required. Actuators shall have a position indicator for external indication of damper position. Actuators shall have manual override capability without disconnecting damper linkage.

K. Control Dampers

1. Motorized dampers, unless otherwise specified elsewhere, shall have damper frames using 13 gauge galvanized steel channel or 1/8” extruded aluminum with reinforced corner bracing. Damper blades shall not exceed ten (10) inches in width or 48” in length. Blades are to be suitable for high velocity performance. Damper bearings shall be as recommended by manufacturer for application. Bushings that turn in the bearing are to be oil impregnated sintered metal. All blade edges and top and bottom of the frame shall be provided with replaceable, butyl rubber or neoprene seals. Side seals may be spring-loaded stainless steel. The seals shall provide a maximum of 1% leakage at a wide open face velocity of 1500 FPM and 4: W.C. close-off pressure. The damper linkage shall provide a linear flow or equal percentage characteristic as required. Provide Ruskin RCD46 model or equal.
2. Control dampers shall be parallel or opposed blade type as scheduled on drawings or outdoor and return air mixing box dampers shall be parallel blade, arranged to direct air streams towards each other. All other dampers may be parallel or opposed blade types.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.

B. Installation of the building automation system shall be performed by the Contractor or a subcontractor. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor.

C. Install system and materials in accordance with manufacturer’s instructions, and as detailed on the project drawing set.

D. Drawings of the TCS and BMCS network are diagrammatic only and any apparatus not shown but required to make the system operative to the complete satisfaction of the Engineer shall be furnished and installed without additional cost.

E. Low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

F. Equipment furnished by the HVAC Controls Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

G. Shop fabricate and assemble all control Panels. Mount and wire BMCS field devices for DDC systems. Make a complete installation. Such devices include, but are not limited to:

1. Direct Digital Control (DDC) of air and water temperature, static and differential pressure sensing and control, damper and valve actuation, variable volume box control, electric relays, switches, transformers, and any and all other devices needed to make a complete system

2. Furnish and install wire, conductors, cables, control devices, panels, conduit etc. required for complete installation of BMCS devices. Make terminations. Check all installation for wiring and termination integrity.

3. Provide control system related materials and installation related to HVAC controls.

    a. Provide new controls for all air handlers, exhaust fans, and HVAC mechanical systems related equipment, its Air Handling Systems, miscellaneous systems and Central Plant.

H. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 WIRING

A. All electrical control wiring and low voltage wiring to the control panels, BMS, computers and network components shall be the responsibility of this contractor.

B. The electrical contractor (Div. 26) shall furnish all power wiring to electrical starters, motors & control panels.

C. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All BMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 26). Non-conduit run wiring is not allowed unless approved before hand by Customer.

3.3 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the Owner

C. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

D. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

E. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

F. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

G. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

H. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.

I. Only glass fiber is acceptable, no plastic.

J. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.4 WARRANTY ACCESS

A. The Owner shall grant to this contractor, reasonable access to the TCS and BMCS during the warranty period.

B. The owner shall allow the contractor to access the TCS and BMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.5 SOFTWARE LICENSE

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

B. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within the BMS. Any and all required ID's and passwords for access to any component or software program shall be provided to the owner.

3.6 ACCEPTANCE TESTING

A. The Supervisor Station including points, graphics, and histories shall be complete and installed before site work.

B. Upon completion of the installation, this contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

C. This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a Point-by-Point Log to validate 100% of the input and output points of the DDC system operation. Log to be shown to the Owner's Representative.

D. System Acceptance: Satisfactory completion is when this contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

E. This contractor shall have 30 days to complete or repair any issues or deficiencies found during the acceptance Testing.

3.7 OPERATOR INSTRUCTION, TRAINING

A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.

B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.

C. The control contractor shall conduct six (6) four-hour training courses for the designated owners personnel in the maintenance and operation of the control system. One class shall be given before system acceptance and the others monthly into the warranty/guarantee time period.

D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:

1. HVAC system overview
2. Operation of Control System
3. Function of each Component
4. System Operating Procedures
5. Programming Procedures
6. Maintenance Procedures

3.8 DATA CONTROL AND GRAPHIC SUMMARY

A. General:

1. List of hardware points for each DDC controller appears on Mechanical Drawings. Graphics showing these points, along with appropriate pseudo points (i.e. set points, etc.) shall be incorporated into operational graphics.

a. Provide software graphics and programming required to accomplish detailed sequence of operations.

3.9 POST INSTALLATION – SYSTEM SETUP, INSTALLATION AND CHECKOUT

A. General – All work is the responsibility of the Controls subcontractor

B. On-Site Supervision – provide:

1. Responsibility for the overall control system installation.
2. Oversight supervision of the control hardware and wiring installation team.

C. Controls Contractor shall provide:

1. Key personnel as required to meet the following on-site requirements:

a. General project supervision of on-site control work

1) Maintain regular contact with Balancing Contractor, and Facility Manager to ascertain ongoing project status.

2) Provide installation information when requested.

3) Provide, at minimum, on-site inspections at following intervals

a) Beginning of installation phase (initial kick-off meeting with contractors)
b) System checkout and commissioning.

C. Participate with Test and Balance contractor to affect a complete and functional system. Provide material to make a full and complete report of work undertaken and final conditions obtained.

3.10 IDENTIFICATION

A. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.

B. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.

C. Junction box covers will be marked to indicate that they are a part of the BAS system.

D. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.

E. All I/O field devices inside FIP's shall be labeled.

3.11 LOCATION

A. The location of sensors is per mechanical and architectural drawings.

B. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.

C. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.

D. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

PART 4 - SEQUENCE OF OPERATION

4.1 VAV FAN SYSTEMS RTU-1 THROUGH RTU-10

A. These VAV fan systems each consist of a supply fan array driven by a VFDs, a relief fan array driven by a VFDs, a preheat coil, a cooling coil, filters & modulating opposed blade outdoor air, return air, and relief air dampers.

B. The supply fan shall be started from a local DDC controller.

C. The supply fan shall run during normal occupied mode and cycle to maintain minimum space temperature and minimum discharge air temperature during unoccupied.

D. Fan system operation in HAND or AUTO mode shall be subject to freezestat, building fire alarm, supply duct high static pressure, inlet high negative static pressure, and door interlock switches. In the AUTO mode the fan system shall also be subject to building optimal start-stop programs, and other conditions or logic pre-programmed into the DDC controllers.

E. The control system shall monitor the amp draw of all VFD's for all fan systems (supply, exhaust, relief). Fan status of operation shall be determined by the amp draw. An alarm shall be generated if a fan is commanded on and fails to start.

F. A current monitoring switch shall be installed on each fan in each fan array system. These switches shall be wired in series and connected to the DDC controller in a way that if one of the fans in the fan array fail an alarm shall be sent to the controller.

G. If the fan system is shut-down, or fails to start due to abnormal conditions, a 'Safeties Alarm' shall be sent to the DDC system. When the fan is stopped under any condition, the outside air dampers and relief air dampers shall close and the relief fans shall stop. A manual reset, high limit pressure switch within the fan room sensing supply duct static pressure shall shut down the fan and alarm the DDC system if its setting is exceeded. A high negative pressure switch located at the fan inlet shall shut down the fan and alarm the DDC system if its set point is exceeded. A manual reset averaging freezestat located downstream of the heating coil shall shut down the fan, open the coil valve and alarm the DDC system if the coil leaving temperature below 40 degrees F is exceeded. Labeled and illuminated indication shall be provided inside the DDC panel to indicate to the maintenance personnel the nature of the malfunction.

H. The ATC contractor shall wire the air handler door interlock switch to prevent fan operation when the door is open.

I. The fan system shall perform an optimal start program that shall include building warm-up and building purge features. In the warm-up mode, all outside air and relief air dampers shall

remain closed, the relief fan shall remain off, and the air handler shall open the pre-heat coil valve 100% to discharge as warm of air as possible into the building. In this mode, the air dampers on the VAV boxes shall be reversed from their normal operation to allow the dampers to close as the room they control begins to warm up. In the purge mode, the preheat coil and cooling coil valves shall remain closed, the outside air and relief air dampers shall open to 100%. In purge mode, the relief fan system shall operate as in the occupied mode.

J. OCCUPIED mode: A supply air temperature sensor and an outdoor air temperature sensor, acting through DDC controllers, shall modulate the pre-heating and cooling coil valves, outdoor air and return air dampers to maintain supply air temperature according to the following schedule:

Primary Reset:

GREATEST VAV COOLING LOAD	SUPPLY AIR TEMPERATURE
0%	70°F
100%	52°F

K. The pre-heat coil, cooling coil, outside air and return air dampers and evaporative cooling stages shall operate in sequence without overlap to maintain the supply air temperature.

L. The relief fan array shall operate whenever the building is in the occupied or purge mode.

M. The operating sequence for the outside and return air dampers shall be as follows: When a call for more outside air is received, the outside air dampers shall modulate open while the return air dampers remain at 100%. Once the outside air dampers are 100% open, the return air dampers shall begin to modulate closed. When a call for less outside air is received, the above sequence shall be reversed. The purpose is to keep the dampers open as much as possible to minimize the pressure drop across the dampers to save fan energy and provide better controllability.

N. The heating coil or cooling coil valve shall open for either heating or cooling depending on the supply air setpoint temperature.

O. The cooling section consists of a cooling.

P. Outside air is the first stage of cooling.

Q. The cooling coil valve shall modulate open in cooling mode as the second stage of cooling.

R. The cooling valve shall remain closed for cooling or heating when the outside air temperature is below 65 degF (adj.) The heating valve shall also modulate open for preheat as the discharge temperature falls below the discharge air temperature set point.

S. The outside air dampers shall maintain a minimum position sufficient to meet the minimum scheduled CFM fresh-air requirements. If the VAV boxes in each room have modulated to maximum ventilation and the air-quality sensors located in each room detect CO2 levels in the space in excess of the CO2 set point (ppm), the minimum CFM set-point shall be adjusted up

to the maximum scheduled fresh-air requirements. Total outside air flow shall be reported to the DDC system by a matrix element style Ebtron flow meter.

T. The minimum fresh-air set-point shall be maintained anytime the air handler is in the occupied mode and no VAV boxes require additional ventilation.

U. A 0-5" w.c. Supply duct static pressure transmitter with its static tip located 2/3 of the way down the supply duct and acting through a DDC controller shall modulate supply fan speed to maintain the supply duct static pressure set point as described below.

V. The supply duct static pressure set point shall be continually adjusted by the DDC controller through a PID control loop to ensure that at least one of the VAV box dampers served by the air handler is at least 85% open. The intent of this control loop is to ensure that the supply fan VFD operates at the lowest possible speed to maintain air flow requirements on all VAV boxes. The supply duct static pressure PID control loop shall adjust the discharge set point between 0.2" and 1.0" w.c. (adjustable) as required by the VAV box dampers.

W. An averaging style air temperature sensor, acting through a DDC controller, shall provide 45°F discharge air temperature low limit control of the air handling system acting as a pre-freezestat.

X. The relief fan array shall be enabled when the building is in the occupied or purge modes.

Y. A –0.25 to 0.25"w.c. static pressure transmitter with an outside probe, must be a Dwyer A306, and an interior probe located in an interior hallway in area served by the fan, acting through the DDC system shall modulate the relief fan VFD's to maintain 0.05"w.c.maximum building static pressure. The building static pressure sensor and the relief dampers shall all be connected to the same DDC controller as the air handler serving the space. The relief system shall be in operation whenever the building is in the occupied mode and supply fan is running. Whenever the relief fan is not in operation, the relief damper shall spring-return closed.

Z. A differential pressure sensor shall be installed across the relief dampers. As the lead relief fan turns on and begins to modulate, the relief damper shall begin to modulate to maintain a 0.05" pressure drop across the damper. As the pressure across the relief damper begins to drop, the damper shall modulate closed to maintain the 0.05" set point.

AA. A temperature sensor shall be installed approximately 2 feet from the inlet of the relief fan system. In the unoccupied mode, if this temperature falls below 50 degrees F, the air handler shall be enabled (with the relief fans off) to circulate air in the plenum to prevent freezing.

BB. Daily total runtimes shall be displayed on the air handler graphic page for each piece of air handler equipment (supply fan, exhaust fan, relief fan, evaporative cooling pump, etc.). The daily runtime value shall be recorded for reporting purposes then reset at the end of each day.

CC. The DDC system shall also provide negative building pressure control for the space that it serves. If the building static pressure begins to fall below the minimum building static pressure set point of 0.01"w.c., the controller shall send a signal to the outside air dampers to open to allow negative building pressure control.

DD. UNOCCUPIED mode: The lowest space temperature sensor served by the air handler, acting through a DDC controller, shall cycle the supply fan to maintain desired minimum space temperature. All perimeter zones have hot water radiation which should be used as the first stage of heat to maintain the unoccupied set point. The fan should be able to remain off during unoccupied hours and should be the last stage of heat used to maintain the unoccupied set point (except during morning warm-up). The outdoor air & relief air dampers shall remain closed and the pre-heat water coil valve shall open to 100%.

4.2 SINGLE ZONE VAV FAN SYSTEM

A. The supply fan shall be started from a local DDC controller.

B. The supply fan shall run during normal occupied mode and cycle to maintain minimum space temperature and minimum discharge air temperature during unoccupied.

C. Fan system operation in HAND or AUTO mode shall be subject to freezestat, building fire alarm, supply duct high static pressure, inlet high negative static pressure, and door interlock switches. In the AUTO mode the fan system shall also be subject to building optimal start-stop programs, and other conditions or logic pre-programmed into the DDC controllers.

D. The control system shall monitor the amp draw of all VFD's for all fan systems (supply, exhaust, relief). Fan status of operation shall be determined by the amp draw. An alarm shall be generated if a fan is commanded on and fails to start.

E. A current monitoring switch shall be installed on each fan in each fan array system. These switches shall be wired in series and connected to the DDC controller in a way that if one of the fans in the fan array fail an alarm shall be sent to the controller.

F. If the fan system is shut-down, or fails to start due to abnormal conditions, a 'Safeties Alarm' shall be sent to the DDC system. When the fan is stopped under any condition, the outside air dampers and relief air dampers shall close and the relief fans shall stop. A manual reset, high limit pressure switch within the fan room sensing supply duct static pressure shall shut down the fan and alarm the DDC system if its setting is exceeded. A high negative pressure switch located at the fan inlet shall shut down the fan and alarm the DDC system if its set point is exceeded. A manual reset averaging freezestat located downstream of the heating coil shall shut down the fan, open the coil valve and alarm the DDC system if the coil leaving temperature below 38 degrees F is exceeded. Labeled and illuminated indication shall be provided inside the DDC panel to indicate to the maintenance personnel the nature of the malfunction.

G. The ATC contractor shall wire the air handler door interlock switch to prevent fan operation when the door is open.

H. The fan system shall perform an optimal start program that shall include building warm-up and building purge features. In the warm-up mode, all outside air and relief air dampers shall remain closed, and the air handler shall open the heating coil valve to maintain supply air setpoint temperature. In the purge mode, the preheat coil and cooling coil valves shall

remain closed, the outside air and relief air dampers shall open to 100%, the relief fan system shall operate as in the occupied mode.

I. OCCUPIED mode: A supply air temperature sensor and an outdoor air temperature sensor, acting through DDC controllers, shall modulate the pre-heating and cooling coil valves, outdoor air and return air dampers to maintain supply air temperature according to the following schedule:

Primary Reset:

ROOM COOLING LOAD	SUPPLY AIR TEMPERATURE
0%	72°F (adj.)
100%	52°F

J. The pre-heat coil, cooling coil, outside air and return air dampers shall operate in sequence without overlap to maintain the supply air temperature.

K. The relief fan array shall operate whenever the building is in the occupied or purge mode.

L. The operating sequence for the outside and return air dampers shall be as follows: When a call for more outside air is received, the outside air dampers shall modulate open while the return air damper modulates closed. Once the outside air dampers are 100% open, the return air dampers shall fully closed. When a call for less outside air is received, the above sequence shall be reversed.

M. The cooling section consists of a cooling coil.

N. Outside air is the first stage of cooling.

O. The cooling coil valve shall modulate open in cooling mode as the second stage of cooling.

P. The cooling valve shall remain closed for cooling when the outside air temperature is between 50 and 65 deg F. As the discharge temperature falls below the discharge air temperature set point, the cooling valve shall close and the heating valve shall modulate open to maintain discharge air temperature.

Q. The outside air dampers shall maintain a minimum position sufficient to meet the lower minimum scheduled CFM fresh-air requirements. If the supply fan has modulated to its maximum supply airflow and the air-quality sensors located in each room detect CO2 levels in the space in excess of the CO2 set point (ppm), the minimum outside airflow set-point shall be adjusted up to the maximum scheduled fresh-air requirements.

R. Airflow sensing shall be a matrix element Ebtron Gold or equivalent CFM sensor. Total airflow shall be reported to the DDC system. Flow meters shall be installed in the following locations:
   1. Outside Airflow

S. The low-end minimum fresh-air set-point shall be maintained anytime the air handler is in the occupied mode.

T. Room space temperature sensing shall be from a wall-mounted temperature sensing element. A painted wooden block shall be installed behind the temperature sensor to provide thermal isolation from the masonry wall. A heavy-duty thermostat guard shall be provided for the temperature sensor in the multi-purpose room.

U. The DDC controller shall modulate the supply fan VFD between minimum and maximum design supply airflow and modulate the heating and cooling as required to maintain setpoint temperature. A PID loop shall determine the appropriate discharge air temperature to maintain setpoint. The temperature and airflow setpoints shall control similar to the VAV boxes.

V. Initial space temperature set points shall be 70-degF (adj.) heating and 74-degF (adj.) cooling when the building is occupied. Unoccupied set point shall be 60-degF (adj.) heating with no cooling setpoint.

W. An averaging style air temperature sensor, acting through a DDC controller, shall provide 45°F discharge air temperature low limit control of the air handling system acting as a pre-freezestat.

X. The relief fan array shall be enabled when the building is in the occupied or purge modes.

Y. When unoccupied, the relief damper shall be closed, the relief fans shall remain off and outside air damper closed, and the return air damper shall remain open.

Z. When occupied, the relief airflow shall match the outside airflow, minus an offset determined by the balancer to maintain a positive space. When occupied, the above dampers (relief & outside air) shall be open, and the relief fan shall control to maintain airflow offset. A differential pressure sensor shall be installed across the relief air damper. When the relief fan is running, the relief air damper shall modulate to maintain a differential pressure of 0.05” w.g. Whenever the air-handler is deactivated, the outside air and relief air dampers shall spring return closed.

AA. A temperature sensor shall be installed approximately 2 feet from the inlet of the relief fan system. In the unoccupied mode, if this temperature falls below 50 degrees F, the air handler shall be enabled (with the relief fans off) to circulate air in the plenum to prevent freezing.

BB. Daily total runtimes shall be displayed on the air handler graphic page for each piece of air handler equipment (supply fan, relief fan, etc). The daily runtime value shall be recorded for reporting purposes then reset at the end of each day.

CC. The DDC system shall also provide negative building pressure control for the space that it serves. If the building static pressure begins to fall below the minimum building static pressure set point of 0.01”w.c., the controller shall send a signal to the outside air dampers to open to allow negative building pressure control.

DD. UNOCCUPIED mode: The air handler, acting through a DDC controller, shall cycle the supply fan to maintain desired minimum space temperature. The outdoor air & relief air dampers shall remain closed and the pre-heat water coil valve shall open to maintain setpoint temperature.

4.3 AIR FLOW METERS (EBTRON OR EQUIVILENT)

A. All outside air flow shall be monitored by a matrix element style Ebtron Gold flow meter or equivalent.

B. Ebtron meters shall be tied to the control system via Lontalk interface to monitor all available data.

4.4 FIRE ALARM FAN SHUT DOWN (All Fan Systems)

A. All heating, ventilating and air conditioning system supply fans shall automatically shut off when the building fire alarm system is energized. All fans to automatically start up again when fire alarm system is reset. Fire alarm system fan relays shall be "normally energized" and shall be installed by Division 26 at each fan system.

4.5 BUILDING HEATING AND COOLING LOOPS

A. There are two main building water loops in the building. One is the cooling loop which serves the air-handling unit cooling coils. The other is the glycol preheat loop and serves the preheat coils in the air handlers, VAV reheat boxes, and cabinet unit heaters.

4.6 SINGLE WATER COOLED CHILLER AND COOLING TOWER

a. Chiller - Run Conditions:

b. The chiller shall be enabled to run whenever:
1. A definable number of chilled water coils need cooling
2. AND the outside air temperature is greater than 54°F (adj.).

c. To prevent short cycling, the chiller shall run for and be off for minimum adjustable times (both user definable), unless shutdown on safeties or outside air conditions.

d. The chiller shall run subject to its own internal safeties and controls.

e. Emergency Shutdown:
1. The chiller shall shut down and an alarm generated upon receiving an emergency shutdown signal status.

f. Refrigerant Detection:
1. The chiller shall shut down and an alarm generated upon receiving a refrigerant leak detection status.

2. Chilled Water Pump - Lead/Lag Operation:

a. The chilled water pumps shall run anytime the chiller is called to run. The lead chilled water pump shall also run for freeze protection whenever the outside air temperature is less than a user definable setpoint (adj.).

b. The two variable speed chilled water pumps shall operate in a lead/lag fashion.
1. The lead pump shall run first.

2. On failure of the lead pump, the lag pump shall run and the lead pump shall turn off.
3. On decreasing chilled water differential pressure, the lag pump shall stage on and run in unison with the lead pump to maintain chilled water differential pressure setpoint.

c. The designated lead pump shall rotate upon one of the following conditions (user selectable):
1. Manually through a software switch
2. If pump runtime (adj.) is exceeded
3. Daily
4. Weekly
5. Monthly

d. Alarms shall be provided as follows:
1. Chilled Water Pump 1
   a Failure: Commanded on, but the status is off.
   b Running in Hand: Commanded off, but the status is on.
   c Runtime Exceeded: Status runtime exceeds a user definable limit.
   d VFD Fault

2. Chilled Water Pump 2
   a Failure: Commanded on, but the status is off.
   b Running in Hand: Commanded off, but the status is on.
   c Runtime Exceeded: Status runtime exceeds a user definable limit.
   d VFD Fault

e. Chilled Water Differential Pressure Control:
1. The controller shall measure chilled water differential pressure at 2 locations (one in the chiller room and one towards the end of the chilled water loop in the building) and modulate the chilled water pump VFDs in sequence to maintain the lower of the two chilled water differential pressure setpoints.
2. The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.
3. The controller shall modulate chilled water pump speeds valve to maintain a chilled water differential pressure of 20 in w.c. (Chiller room) or 10 in w.c. (Building) (both adj.). The VFDs minimum speed shall not drop below 20% (adj.).
4. On dropping hot water differential pressures, the VFDs shall stage on and run to maintain setpoint as follows:
   a The controller shall modulate the lead VFD to maintain both setpoints. (worst case)
   b If the lead VFD speed is greater than a setpoint of 90% (adj.), the lag VFD shall stage on.
   c The lag VFD shall ramp up to match the lead VFD speed and then run in unison with the lead VFD to maintain both setpoints. (worst case)
5. On rising chilled water differential pressure, the VFDs shall stage off as follows:
   a If the VFDs speeds drops back to 60% (adj.) below setpoint, the lag VFD shall stage off.
   b The lead VFD shall continue to run to maintain both setpoints. (worst case)

6. Alarms shall be provided as follows:
   a High Hot Water Differential Pressure: If 25% (adj.) greater than setpoint.
   b Low Hot Water Differential Pressure: If 25% (adj.) less than setpoint.

3. **CONDENSER WATER PUMP LEAD/STANDBY OPERATION:**

a. The condenser water pumps shall run anytime the chiller is called to run.

b. The lead pump shall start prior to the chiller being enabled and shall stop only after the chiller is disabled. The pumps shall therefore have:
1. A user adjustable delay on start.
2. AND a user adjustable delay on stop.

c. The delay times shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

d. The condenser water pumps shall operate in a lead/standby fashion.
1. The lead pump shall run first.
2. On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.

e. The designated lead pump shall rotate upon one of the following conditions (user selectable):
1. manually through a software switch
2. if pump runtime (adj.) is exceeded
3. daily
4. weekly
5. monthly

f. Alarms shall be provided as follows:
1. Condenser Water Pump 1
   a Failure: Commanded on, but the status is off.
   b Running in Hand: Commanded off, but the status is on.
   c Runtime Exceeded: Status runtime exceeds a user definable limit.
2. Condenser Water Pump 2
   a Failure: Commanded on, but the status is off.
   b Running in Hand: Commanded off, but the status is on.
   c Runtime Exceeded: Status runtime exceeds a user definable limit.

4. **CHILLER:**

a. The intent of the indirect cooling is to keep the chiller off for more hours in the swing seasons utilizing waterside economizer to maintain building temperature. There are diverting valves in both the chilled water and condenser water to direct flow either through the chiller or the flat plate heat exchanger. When the chiller is enabled, flow shall be directed through the chiller, when the chiller is scheduled off, the flow shall be directed through the heat exchanger. The chiller shall be enabled a user adjustable time after pump statuses are proven on. The chiller shall therefore have a user adjustable delay on start.

b. The delay time shall be set appropriately to allow for orderly chilled water system start-up, shutdown and sequencing.

c. The chiller shall run subject to its own internal safeties and controls.

d. Alarms shall be provided as follows:
1. Chiller Failure: Commanded on, but the status is off.
2. Chiller Running in Hand: Commanded off, but the status is on.
3. Chiller Runtime Exceeded: Status runtime exceeds a user definable limit.

e. Chiller Chilled Water Supply Setpoint:
1. The chiller shall maintain a chilled water supply temperature setpoint as determined by its own internal controls (provided by others).

5. **COOLING TOWER VFD FAN - CONDENSER WATER TEMPERATURE CONTROL:**

a. The controller shall measure the cooling tower condenser water supply (basin) temperature and modulate the fan VFD to maintain setpoints.

b. The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions.

c. On rising supply temperature, the controller shall modulate the VFD to maintain a setpoint of 78°F (adj.).

d. On a call for cooling tower, the cooling tower intake dampers will open. The cooling tower will not be allowed to start until the dampers are proven open.

e. Alarms shall be provided as follows:
1. Fan
   a Failure: Commanded on, but the status is off.
   b Running in Hand: Commanded off, but the status is on.
   c Runtime Exceeded: Status runtime exceeds a user definable limit.
   d VFD fault.
2. High Cooling Tower Supply (Basin) Temp: If greater than 86°F (adj.).
3. Low Cooling Tower Supply (Basin) Temp: If less than 38°F (adj.).

f. Chilled Water Temperature Monitoring:
1. The following temperatures shall be monitored:
   a Chilled water supply.
   b Chilled water return.

g. Alarms shall be provided as follows:
1. High Chilled Water Supply Temp: If the chilled water supply temperature is greater than 55°F (adj.).
2. Low Chilled Water Supply Temp: If the chilled water supply temperature is less than 38°F (adj.).

h. Condenser Water Temperature Monitoring:
1. The following temperatures shall be monitored:
   a Condenser water supply temperature.
   b Condenser water return temperature.
2. Alarms shall be provided as follows:
   a High Condenser Water Supply Temp: If the condenser water supply temperature is greater than 86°F (adj.).
   b Low Condenser Water Supply Temp: If the condenser water supply

temperature is less than 65°F (adj.).

c High Condenser Water Return Temp: If the condenser water return temperature is greater than 100°F (adj.).

d Low Condenser Water Return Temp: If the condenser water return temperature is less than 75°F (adj.).

4.7 GLYCOL PREHEAT LOOP CONTROL

A. The main heating water loop pumps shall run as follows: The preheat pump shall run continuously when the building is occupied and the outside air temperature is below 50° (preheat mode). Also, if the building is unoccupied and any fan system is operating to heat the building or if an air handler is operating in warm-up mode the lead pump shall be enabled (preheat mode). The local DDC controllers shall alternate the lead pump on a monthly basis. If a pump does not run when it is commanded to do so, the second pump shall start and an alarm shall be sent to the DDC system.

B. The two building preheat water pumps are controlled by VFD's. The DDC system shall modulate the pump VFD speed to maintain a preheat water differential pressure set point of 10 PSI (adjustable). This set point shall be coordinated with the balancer to make sure the set point meets field conditions.

C. Provide supply and return temperature sensors in the preheat loop connected to the DDC system.

D. The controls contractor shall provide a pressure sensor for monitoring the preheat loop pressure. The sensor shall be hardwired back the DDC controller responsible for controlling the preheat water pump VFD speed. No indirect or software points will be acceptable. The pressure sensor shall be located near the end of the main building water loop in the furthest air handler as indicated by the engineer.

E. Status indication of pump operation will be from the analog current signal provided at the VFD for each pump. The control system will monitor the amps and provide pump status from the amp signal. The VFD status shall enable the VFD control loop. Loss of VFD status shall enable the lag pump. Verification of either pump status point shall enable the heating pumps as required to control the temperature of the loop.

F. Preheat mode for the loop shall be when the building is in the occupied mode and the outside air temperature is below 50° (adj.) or when the building is in the unoccupied mode and the air handler is in the warm-up mode. In the glycol preheat mode, the lead heat exchangers (HX-2A or HX-2B) shall be enabled. When enabled the glycol side 2-position valve shall fully open, and the hot water side valve shall modulate to maintain setpoint temperature. The heat exchangers are fully redundant.

4.8 HEATING LOOP CONTROL

A. Each boiler pump shall run when the associated boiler is enabled and run for 15 minutes after the boiler is disabled.

B. The main loop pumps (primary/standby) shall run as follows: The lead heating pump shall run continuously when the building is occupied and the outside air temperature is below 58° (adjustable) or a zone served by the air handlers is calling for heat. Also, if the building is

unoccupied and any zone served by the air handlers is calling for heat, if an air handler is operating in warm-up mode, or the outside air temperature is below 30° the lead pump shall be enabled. The local DDC controllers shall alternate the lead pump on a monthly basis. If a pump does not run when it is commanded to do so, the second pump shall start and an alarm shall be sent to the DDC system. The pumps shall run anytime B-1 or B-2 are enabled.

C. The two building heating water pumps are controlled by VFD's. The DDC system shall modulate the pump VFD speed to maintain a heating water differential pressure set point of 10 PSI (adjustable.) This setpoint shall be coordinated with the balancer to maker sure the setpoint meets field conditions.

1. A pressure sensor for monitoring the heating loop pressure will be provided. The sensor shall be hardwired back the DDC controller responsible for controlling the heating water pump VFD speed. No indirect or software points will be acceptable. The pressure sensor shall be located near the end of the main building water loop as indicated by the engineer.

D. Provide supply and return temperature sensors in the heating loop connected to the DDC system.

E. Status indication of pump operation will be from the analog current signal provided at the VFD for each pump. The control system will monitor the amps and provide pump status from the amp signal. The VFD status shall enable the VFD control loop. Loss of VFD status shall enable the lag pump. Verification of either status point shall enable the water to water heat pump, boiler, and pumps as required to control the temperature of the loop.

F. The basis of design boiler is furnished with a hydronic control system. A Lontalk interface (coordinate with boiler manufacturer) from the control system to the boiler will be provided. The controls shall monitor the operation of B-1 & B-2 through the interface but control of the boiler will be through physical wiring connections. Software enable and control is not permitted.

G. The boilers shall be enabled anytime the heating loop is enabled, and to maintain setpoint temperature. The setpoint temperature shall reset based on outdoor air temperature:

Outdoor Air Temperature	Hydronic Setpoint
Below 45°F	140°F (adjustable)
Above 45°F	120°F (adjustable)

4.9 EMERGENCY SHUTDOWN SWITCHES (Boilers & Water Heaters)

A. A remote mushroom type, single acting, manually reset, shutdown switch shall be located just inside each boiler room door and marked for easy identification. A pilot light shall illuminate whenever the push button is pressed. If there is more than one door to the boiler room, there should be a switch located at each door.

B. The emergency shutdown switch(es) when activated must disconnect all power to the boiler burner and all hot water heater controls. A visual alarm indicator of a different color than the building fire alarm indicators shall be activated when the boilers are shutdown.

4.10 VAV BOX CONTROL

A. VAV boxes will have reheat coils.

B. Room space temperature sensing shall be from wall-mounted temperature sensing elements with adjustable set points (Slide-stats). Room CO2 sensing shall be by a separate wall mounted CO2 sensor (located in the breathing zone). The CO2 sensor shall be of self-calibrating type.

C. The space sensors located in the hallways and toilet rooms shall not have temperature adjustment capability (Slide-stat) or CO2 sensor monitoring. (Collaborative areas are not hallways).

D. A duct style temperature sensor shall be installed at each VAV box air discharge.

E. Each VAV box shall be connected to the motion sensor provided by division 26 for lighting control. VAV boxes located in the hallways and commons areas shall not have a motion sensor. The occupancy sensor through the DDC system and a maintained time delay relay shall return the VAV box back to a vacant state when no motion is sensed for 30 minutes (adjustable).

F. All VAV boxes shall be programmed to occupied mode each morning the building is scheduled for occupancy until 8:00 am (adjustable) to allow the building to warm-up or purge as required. After 8:00 am, the motion sensors in each room shall determine occupancy or vacancy of the VAV box.

G. A VAV box-mounted DDC controller shall be provided for control and operation of each VAV reheat coil. The controller shall modulate the VAV box primary air damper between minimum ventilation position and maximum designed airflow and modulate the reheat coil valve in sequence to maintain the desired space temperature. Heating and cooling set points shall be individually adjustable from the man-machine interface device (Host computer) or the District offices.

H. Initial space temperature set points shall be 70° heating and 74° cooling when the building is occupied. Unoccupied set point shall be 60° heating with no cooling set point. The initial slide stat adjustment range shall be set to 1°.

I. Unless scheduled otherwise, all reheat VAV boxes shall maintain the minimum CFM set point for heating.

J. The primary air damper of the VAV box shall be capable of reversing operation as required for building warm-up or central plant heat applications.

K. All classrooms, media center, and collaborative areas will utilize demand controlled ventilation to determine their minimum CFM set point. If the CO2 level in the space falls below the CO2 set point (ppm), the minimum CFM set point can be adjusted down to zero. As the CO2 level begins to rise above the CO2 set point (ppm), the minimum CFM set point of the VAV box will be adjusted up to the maximum scheduled CFM to satisfy the CO2 levels. If the VAV box is operating at maximum CFM and the CO2 level is not satisfied, a

signal shall be sent from the VAV box to the air handler to increase the outside air ratio allowing more fresh air into the space.

L. If the occupancy sensor determines that the space is vacant, the VAV box minimum ventilation will be set to zero. In the vacant mode, the space temperature set point shall remain in effect and the temperature control will override the vacancy mode to maintain the space temperature set point as required.

M. A spreadsheet style quickview graphic shall be provided to show VAV box operational status. The following points shall be displayed for each VAV box: Occupancy, Space Temp, Space Temp set point, Damper position, HW valve position, %Load, CO2 level, CFM air flow, CFM set point, Discharge Temperature, BTU load of the space, BTU total consumption for the day shall be displayed.

N. Each VAV box DDC controller shall have a 24-volt power connection with all 24-volt control wiring by the ATC contractor. Transformers for the VAV controllers shall be centrally located in the respective air handler equipment room.

O. Each VAV interface controller shall be loaded to a maximum capacity of 90%. 10% spare space shall be provided to allow for expansion and additional programming.

P. fan is commanded on, but the status is off.

4.11 AREA SECURITY TEMPERATURE ALARMS

A. Temperature sensors located in an area served by each fan system shall continuously monitor the space temperature and alarm the building Host computer anytime the space temperature drops below or rises above preset set points.

B. Upon receiving an alarm the Host computer at the school and at the District Offices shall indicate which area(s) of the building are in alarm through a graphic floor plan display of the building(s). Current space temperatures shall also be displayed at the Host computer.

4.12 DOMESTIC HOT WATER SYSTEMS

A. All domestic hot water systems and associated building loop pumps shall be enabled through the DDC system. All domestic hot water pumps shall run during occupied hours as scheduled by the BAS as needed to maintain a return water temperature of 130 degrees F and a storage tank temperature of 130 F. A temperature sensor shall be connected to each hot water system and storage tank for remote monitoring capability of the domestic hot water temperature. Status of the domestic water pumps shall be monitored by the control system and an alarm shall be generated if a pump fails to operate.

B. The domestic hot water heaters shall operate 24 hours a day to prevent bacteria build-up. Once enabled by the DDC system, the domestic hot water heaters shall operate under their factory supplied controls.

C. Tie-in water heaters Lontalk communication.

4.13 CABINET UNIT HEATER CONTROL

A. A room temperature sensor, shall cycle the unit heater fan and valve to maintain desired room space temperature. The unit heater fan shall not be controlled by an aqua-stat.

4.14 EXHAUST FANS

A. Independent exhaust fans shall be enabled by the control system. Status of fan operation shall be monitored via a current monitoring switch. If the exhaust fan fails to start an alarm shall be generated.

B. Exhaust fans will be enabled to operate during building occupied or building purge (cool-down) periods.

4.15 EXHAUST AIR/MAU SYSTEM IN KITCHEN

A. The kitchen MAU and Exhaust fan come as separate pieces of equipment.

B. The ATC contractor shall interlock the kitchen grease hood exhaust fan with Make-up Air Unit. If the kitchen grease hood is in operation, the unit shall be enabled. The ATC contractor shall furnish and install any necessary interlocking relays and switches.

C. The Make-up Air Unit evaporative cooler sump drain and fill valves shall be provided and controlled by the ATC contractor. The sump shall be drained each night at the end of the occupied period. The sump shall be filled each day on a call for cooling as required. If the outside temperature drops below 40 deg. F, the sump shall be drained and the fill line shall shut off and the riser drained for freeze protection.

D. The ATC contractor shall interlock the kitchen dishwasher exhaust hood fan with the make-up air handler serving the area. If the kitchen dishwasher exhaust hood is in operation, the unit shall be enabled. Conversely, if the make-up air unit is running, the dishwasher exhaust shall be enabled (in order to maintain pressurization.) It is anticipated that the kitchen hood will only be used during occupied hours in which case more than enough make-up air is available. The ATC contractor shall furnish and install any necessary interlocking relays and switches.

E. The ATC contractor shall install and wire the temperature sensors and manual override switches which shall enable the kitchen hoods when the temperature is too great.

F. Daily total runtime of the kitchen exhaust hood and makeup air unit shall be displayed on the graphic page. The daily runtime value shall be recorded for reporting purposes then reset at the end of each day. If the runtime exceeds 12 hours in any one day, an email shall be sent to district personnel.

4.16 FREEZER AND REFRIDGERATER TEMPERATURE ALARMS

A. The ATC contractor shall provide a temperature sensor in each refrigerator and freezer that are tied to the DDC system. The DDC system shall alarm the district Host Computer if the temperatures are out of range.

4.17 FIRE RISER TEMPERATURE MONITORING

A. A temperature sensor shall be provided and connected to the control system to monitor the temperature near the fire risers. If the temperature falls below 45° an alarm shall be generated and an email shall be sent to district personnel.

B. When the temperature falls below 45°, the control system shall enable the hvac equipment serving the area to warm-up the space.

4.18 OUTSIDE AIR TEMPERATURE MONITORING

A. The outside air temperature sensor shall be contained within a wooden instrument enclosure. The location and design of such shall provide a signal to the DDC system that is accurate to within +/- 2 degrees F, regardless of building mass, sun location or other environmental conditions.

B. An additional outside air temperature sensor reading shall be obtained via internet connection to a local weather station. The most accurate and most reliable temperature reading shall be used to control the building.

C. If the internet connection is used, the local sensor shall serve as a backup when the internet reading becomes unreliable.

4.19 GLYCOL FEED SYSTEMS

A. The ATC contractor shall wire all misc. power and pressure sensors provided with the equipment to make the systems completely operational.

4.20 HOST COMPUTER & BUILDING GRAPHIC DISPLAY

A. Graphics pages shall be made to match the existing graphics on the districts host computer. Floor plans, air handler summaries, and alarm pages shall all be included.

B. Runtimes of all air handlers, relief fans, exhaust fans, boilers, chillers, and equipment pumps shall be logged at the host computer. The ATC contractor shall provide runtime reports to enable monitoring of the building performance.

4.21 CO2 CONCENTRATION SET POINTS

SPACE	CO2 CONCENTRATION SETPOINT (PPM)
RECEPTION	1600
CLASSROOM (K-3)	850
CLASSROOM (4+)	900
ART CLASSROOM	1100
DINING	1400
MEDIA CENTER	950
MULTIUSE ASSEMBLY	1700
OFFICE SPACE	900
CONFERENCE	1600

END OF SECTION 23 0900

SECTION 23 1123

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters
7. Mechanical sleeve seals.
8. Grout.
9. Concrete bases.
10. This division is to pay all costs associated with the gas meter that are required by the local gas company/authority.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig but not more than 2 psig.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Dielectric fittings.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Escutcheons.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Field quality-control reports.

I. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.

4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: [**40**] [**60**]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BrassCraft Manufacturing Company; a Masco company.
    b. Conbraco Industries, Inc.; Apollo Div.
    c. Lyall, R. W. & Company, Inc.
    d. McDonald, A. Y. Mfg. Co.
    e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BrassCraft Manufacturing Company; a Masco company.
b. Conbraco Industries, Inc.; Apollo Div.
c. Lyall, R. W. & Company, Inc.
d. McDonald, A. Y. Mfg. Co.
e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lee Brass Company.
b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

a. McDonald, A. Y. Mfg. Co.
b. Mueller Co.; Gas Products Div.
c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flowserve.
    b. Homestead Valve; a division of Olson Technologies, Inc.
    c. McDonald, A. Y. Mfg. Co.
    d. Milliken Valve Company.
    e. Mueller Co.; Gas Products Div.
    f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements,provide products by one of the following

    a. Vanguard Valves, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: 5 psig.
4. Cast-aluminum body with nickel-plated chrome steel internal parts.
5. Nitrile-rubber valve washer.
6. Sight windows for visual indication of valve position.
7. Threaded end connections complying with ASME B1.20.1.
8. Wall mounting bracket with bubble level indicator.

B. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Pacific Seismic Products, Inc.

2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure: [0.5 psig] [7 psig] [60 psig].
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.

9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Actaris.
    b. American Meter Company.
    c. Eclipse Combustion, Inc.
    d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    e. Invensys.
    f. Maxitrol Company.
    g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Hart Industries International, Inc.
    d. McDonald, A. Y. Mfg. Co.

e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.8 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.9 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.10 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.

1. Finish: Polished chrome-plated or rough brass.

D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.

1. Finish: Polished chrome-plated or rough brass.

E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.11 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.12 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install escutcheons at penetrations of interior walls, ceilings, and floors.

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
h. Piping in Equipment Rooms: One-piece, cast-brass type.
i. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
j. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

M. Verify final equipment locations for roughing-in.

N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
b. Do not install natural-gas piping in solid walls or partitions.

S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

T. Connect branch piping from top or side of horizontal piping.

U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

V. Do not use natural-gas piping as grounding electrode.

W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

D. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.6 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.7 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (semigloss).
d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (flat).
d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (flat).
d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 INDOOR PIPING SCHEDULE

A. Aboveground, piping NPS 2 and smaller shall be the following:

1. Steel pipe with wrought-steel fittings and welded or threaded joints.

B. Aboveground, piping NPS 2-1/2" and larger shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints in a vented conduit.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.14 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Bronze plug valve.
2. Cast-iron, nonlubricated plug valve.

END OF SECTION 23 1123

SECTION 23 2113

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Canal-water piping.
4. Makeup-water piping.
5. Condensate-drain piping.
6. Air-vent piping.
7. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Steel pipe and fittings.
2. Copper pipe, tubing and fittings.
3. Dielectric fittings.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports: Written reports as specified in Part 3 of this section including:

1. Test procedures used.
2. Test results showing compliance with specified requirements.
3. Failed test results with corrective action taken to achieve compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. **Drawn-Temper Copper Tubing**: **ASTM B 88, Type L**.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Forged Steel “Olet” Type Fittings, Welding, Socket-Welding and Threaded: ASME B16.11 and ASTM A105.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

J. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide **products by the following provide products by one of the following**:

   a. Victaulic Company.
   b. Anvil International, Inc. (Gruvlok)

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53, Type F, E, or S, Grade B factory-fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders designed and constructed to accept grooved-end couplings.
3. Couplings: Two Ductile- housing and synthetic rubber gasket of central cavity pressure-responsive design; with ASTM A449 electroplated steel nuts and bolts to secure grooved pipe and fittings. Couplings shall comply with ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
   a. Rigid Type: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.

b. Gasket: High temperature EPDM gasket, suitable for water service to +250 deg F, without use of special lubricants.
c. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors.
d. 14" and Larger: Two –segment coupling, with lead-in chamfer on housing key and a wide-width gasket having a center-leg.

4. Combinations of grooved mechanical-joint couplings and short nipples may also be used.

2.3 PLASTIC PIPE AND FITTINGS

A. PP (Polypropylene) Pipe: ASTM F 2389, SDR 7.4 and fiberglass composite reinforced SDR 11.
1. PP Fusion-weld Socket Fittings: ASTM F 2389.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. PP Pipe and Fittings: Manufacturer's recommended fusion-weld system.

2.5 TRANSITION FITTINGS

A. PP-to-Metal Transition Fittings:

1. Description:

a. PP one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
b. One end with threaded brass insert and one fusion-socket end.

2.6 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.Capitol Manufacturing Co.
   c. Capitol Manufacturing Company.
   d. Central Plastics Company.
   e. Elster Perfection.
   f. Grinnell Mechanical Products.
   g. Matco-Norca.
   h. Pipeline Seal and Insulator, Inc.
   i. Precision Plumbing Products, Inc.
   j. Victaulic Company.
   k. Watts Regulator Co.
   l. Zurn Industries, LLC.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. **End Connections:** Threaded, or flanged.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig** minimum working pressure at **225 deg F**.

F. Dielectric Nipples or Waterways: Electroplated steel with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig** minimum working pressure at **225 deg F**.

2.7 BYPASS CHEMICAL FEEDER

A. Description: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

2.8 EXTRA MATERIALS

A. Chemicals: Furnish sufficient water treatment chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be **[any of]** the following:

1. **Type L** drawn-temper copper tubing, wrought-copper fittings, and **soldered** joints.
2. **Schedule 40**, Grade B, Type 96 steel pipe; **Class 125, cast-iron** fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be **[any of]** the following:

1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. **Schedule 40** steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be **[any of]** the following:

1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and **soldered** joints.
2. **Schedule 40**, Grade B, Type 96 steel pipe; **Class 125, cast-iron** fittings; cast-iron flanges and flange fittings; and threaded joints.

D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be **[any of]** the following:

1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and **soldered** joints.
2. **Schedule 40** steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

E. Makeup-water piping installed aboveground shall be **[any of]** the following:

1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and **soldered** joints.

F. Condensate-drain piping shall be **[any of]** the following:

1. **Type M**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

G. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

H. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

I. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.3 PIPING INSTALLATIONS

A. PRE-WORK / PRE-REQUISITES

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

2. The Contractor shall study the architectural, structural, mechanical, electrical and other drawings to eliminate conflict of piping with other structure lighting or other services.

B. CONDITION

1. All installed pipe lines shall be free from dents, scars, and burrs, with ends reamed smooth.

2. All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.

3. Install piping free of sags and bends.

4. All installed pipe lines shall remain straight against strains tending to cause distortion during system operation. The contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage or improper operation results therefrom.

C. SELECTION

1. Select system components with pressure rating equal to or greater than system operating pressure.

2. No street type fittings shall be used.

3. No short nipples shall be used except at drain valves.

4. Plugs of rags, wools, cottons, waste, or similar materials may not be used for plugging.

D. ROUTING/ARRANGEMENT

1. Piping installations shall be neatly organized.

2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

3. Install groups of pipes parallel to each other.

4. Install piping spaced to permit application of insulation.

5. Install piping parallel and spaced to permit the servicing of valves.

6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls or axis of the building.

7. Diagonal runs are prohibited unless specifically indicated otherwise.

8. Install fittings for all changes in direction.

9. No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.

10. Piping shall be arranged, placed and installed to facilitate equipment maintenance and shall be so arranged to not interfere with the installation of the air-conditioning equipment, ducts, or the removal of other equipment or devices. All specialties shall be so placed to permit easy operation and access.

11. All piping shall be so installed to insure noiseless circulation.

12. Install fittings for all branch connections.

13. Unless otherwise indicated, install branch connections to mains using tee fittings or forged steel branch fittings in main pipe, with the branch connected to the bottom of the main pipe.

14. For up-feed risers, connect the branch to the top of the main pipe.

15. Forged branch fittings shall be installed per the manufacturer's recommendations.

E. ACCESS / ARRANGEMENT

1. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. All piping shall be so arranged to not block access to manholes, access openings, etc.

2. Install piping at indicated slopes. If not indicated, install piping at a uniform grade of 0.2 percent where possible, upward in direction of flow. Traps are to be avoided where-ever possible.

3. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

4. When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.

5. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."

6. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated, and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.

7. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated. Install flanges on valves, apparatus, and equipment having 2 ½ inch NPS and larger connections. Flanges or unions as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment.

8. Install shutoff valve immediately upstream of each dielectric fitting. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

9. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides. Anchor piping for proper direction of expansion and contraction.

10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

11. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

12. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

13. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS ¾) nipple and ball valve in blow-down connection of strainers NPS 2) and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2).

14. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration-producing equipment.

15. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.

F. DRAINAGE

1. Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.

2. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

3. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe.

4. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

G. IDENTIFICATION

1. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.4 DIELECTRIC FITTING INSTALLATION

A. Make connections according to the following, unless otherwise indicated:

1. **Install dielectric nipples or waterways** in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install **waterways**, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Install Dielectric Fittings into Hydronic Piping Systems: Install dielectric nipples, waterways or couplings to connect piping materials of dissimilar metals.

4. **End Connections**: **Threaded, or flanged.**

3.5 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Steel roof deck shall not be used to support loads from piping, ductwork or equipment, unless noted otherwise. Hanger loads less than 50 lbs. may be hung from the steel roof deck in cases when hanging from the steel roof deck cannot be avoided; the attachment method must distribute the load across the deck as approved by the Structural Engineer.

D. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

E. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
6. NPS 3 and Larger: Maximum span, 12 feet; minimum rod size, 1/2 inch.

F. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.

G. PVC and CPVC Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

H. PP Piping Hanger Spacing: Install vinyl-coated hangers with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.
7. Space all sizes of fiberglass composite reinforced PP pipe according to the manufacturer's written instructions.

I. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

J. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

K. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

L. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. PP Fusion Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM D2657 and the manufacturer's recommendations.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

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SECTION 23 2116

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes special-duty valves and specialties for the following:
   1. Hot-water heating piping.
   2. Makeup-water piping.
   3. Condensate-drain piping.
   4. Air-vent piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air-control devices.
   3. Hydronic specialties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 VALVES

A. **Globe, Check, Ball, and Butterfly Valves**: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping. Gate valves are not allowed on this project.

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC.

C. Refer to Part 3 “Valve Applications” Article for applications of each valve.

D. Bronze, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 and smaller:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump.
    c. Flow Design Inc.
    d. Gerand Engineering Co.
    e. Griswold Controls.
    f. Taco.
    g. Tour & Andersson; available through Victaulic Company.
    h. Nexus Valve, Inc.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum **125 psig**.
10. Maximum Operating Temperature: **250 deg F**.

E. Cast-Iron or Steel, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 ½ and larger:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Flow Design Inc.
    e. Gerand Engineering Co.
    f. Grinnell.
    g. Griswold Controls.
    h. Taco.
    i. Tour & Andersson; available through Victaulic Company.
    j. Spence Engineering Company Inc.

k. Watts Regulator Co.
l. Nexus Valve, Inc.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum **125 psig**.
11. Maximum Operating Temperature: **250 deg F**.

F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.
f. Watts Regulator Co.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump.
d. Conbraco Industries, Inc.
e. Kunkle.
f. Spence Engineering Company, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.

8. Inlet Strainer: **Brass,** removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump.
    c. Flow Design Inc.
    d. Griswold Controls.
    e. Taco
    f. Nexus Valve, Inc.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Tamper proof, self-cleaning, and removable, for inspections and replacement.
    a. **Corrosion resistant.**
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Attached by chain and marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations:
    a. **Minimum CWP Rating**: **175 psig**.
8. **Maximum Operating Temperature: 200 deg F**.
9. Fitted with pressure and temperature test valves.
10. Equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Amtrol, Inc.
    b. Armstrong Pumps, Inc.
    c. Bell & Gossett Domestic Pump.
    d. Taco, Inc.

2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Manually operated with ball valve in the down position.
6. Inlet Connection: **NPS 1/2**.
7. Discharge Connection: **NPS 1/8**.
8. CWP Rating: **150 psig**.

9. Maximum Operating Temperature: **225 deg F**.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amtrol, Inc.
   b. Bell & Gossett Domestic Pump.
   c. Hoffman Specialty ITT; Fluid Handling Div.
   d. Spirax-Sarco.
   e. Spirovent.
   f. Taco, Inc.
   g. Honeywell-Baukman.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: **NPS 1/2**.
6. Discharge Connection: **NPS 1/4**.
7. CWP Rating: **150 psig**.
8. Maximum Operating Temperature: **240 deg F**.

C. **Bladder** -Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Taco, Inc.

2. Tank: Welded steel, rated for **125-psig** working pressure and **240 deg F** maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. **Bladder** : Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
5. Access: Drain fitting and taps for pressure gage.
6. Support:
   a. Vertical tanks with steel legs or base.
   b. Horizontal tanks with steel saddles.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Taco, Inc.

2. Tank: Welded steel; ASME constructed and labeled for **125-psig** minimum working pressure and **240 deg F** maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for **NPS 2** and smaller; flanged connections for **NPS 2-1/2** and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

2.3 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Machine Works.
    b. Hoffman Specialty ITT; Fluid Handling Div.
    c. Metraflex Co.
    d. Mueller
    e. Spirax Sarco.
    f. Trane Co.
    g. Tour & Andersson; available through Victaulic Company.
    h. Watts Regulator Co.
    i. Nexus Valve

2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Stainless-steel, or perforated stainless-steel basket:
    a. **20**-mesh strainer.
5. CWP Rating: **125 psig**.

B. Basket Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Crane Co.
    b. Metraflex Co.
    c. Mueller
    d. Spirax Sarco.
    e. Tour & Andersson; available through Victaulic Company.

2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Perforated stainless-steel basket with 50 percent free area:
    a. 40-mesh startup strainer.
5. CWP Rating: **125 psig**.

C. Spherical, Rubber, Flexible Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amber-Booth.
   b. Mason Industries.
   c. Metraflex Co.
   d. Flex-Weld.
   e. Fugate.
   f. Twin City Hose.
   g. Nexus Valve, Inc.

2. Body: Double-sphere fiber-reinforced EPDM rubber body.
3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. Performance: Capable of misalignment.
5. CWP Rating: **150 psig**.
6. Maximum Operating Temperature: **250 deg F**.

D. Diverting Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump.
   d. Taco, Inc.

2. Body: Cast Iron or Wrought Copper
3. Ends: Threaded or Soldered
4. Flow Direction: Indicated on fitting.
5. CWP Rating: **125 psig**.
6. Maximum Operating Temperature: **250 deg F**.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. **Install calibrated-orifice,** balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler diptube. Manual air vents may be a better solution.

C. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

D. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

E. Install in-line air separators in pump suction. Install drain valve on air separators **NPS 2** and larger.

F. Install tangential air separator in pump suction. Install blowdown piping with full-port ball valve; extend full size to nearest floor drain.

G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
   1. Install tank fittings that are shipped loose.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 23 2123

HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Domestic water recirculation pumps

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, shipping weights, installed weights, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.
    a. Detail all wiring systems and differentiate clearly between manufacturer-installed and field-installed wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.

B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

C. Regulatory Requirements: Fabricate and test steam condensate pumps to comply with HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.8 COORDINATION

A. Coordinate size and location of concrete bases.

PART 2 - PRODUCTS

2.1 FACTORY STOCK CIRCULATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Crane Pumps & Systems.
4. Flofab
5. Flowserve Corporation.
6. Grundfos Pumps Corporation.
7. ITT Corporation; Bell & Gossett.
8. Mepco, LLC.
9. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.

10. Peerless Pump Company.
11. TACO Incorporated.
12. Thrush Company Inc.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, in-line or motor mounted pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rated for 125-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and **threaded or threaded companion-flange or union-end connections or unions at connections for casings that are not available with threaded companion flanges.**
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw.
3. Pump Shaft: **Steel**, with oil lubricated **copper-alloy shaft sleeve**.
4. **Seal:** Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and **Buna-N** bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings:
   a. Oil lubricated, **bronze-journal**.

D. Motor: Single speed and rigidly or resiliently mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

   a. Enclosure: **Open, dripproof**.
   b. Enclosure Materials:
      1) Cast iron.
   c. Motor Bearings: **Permanently lubricated** ball bearings.
   d. Efficiency:
      1) Premium efficient.
   e. Service Factor: 1.15

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Flofab
4. Grundfos Pumps Corporation.
5. ITT Corporation; Bell & Gossett.
6. Mepco, LLC.
7. PACO Pumps; Grundfos CBG.
8. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.

9. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rated for **175-psig** minimum working pressure and a continuous water temperature of **225 deg F**.

C. Pump Construction:
1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and **threaded or threaded companion-flange or union-end connections or unions at connections for casings that are not available with threaded companion flanges.**
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. **Pump Shaft: Steel,** with oil lubricated copper-alloy shaft sleeve.
4. **Seal:** Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings:
    1. Oil lubricated, **bronze-journal**.

D. Motor: Single speed and rigidly or resiliently mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Enclosure: Open, dripproof.

    b. Enclosure Materials:
        1) Cast iron.

    c. Motor Bearings:
        1) Grease-lubricated ball bearings.

    d. Efficiency:
        1) Premium efficient.
    e. Service Factor: 1.15

2.3 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps Inc.
2. Aurora Pump; Division of Pentair Pump Group.
3. Flofab
4. ITT Corporation; Bell & Gossett.
5. ITT Corporation; Goulds Pumps.
6. PACO Pumps; Grundfos CBG.
7. Patterson Pump Co.; a subsidiary of the Gorman-Rupp Co.

8. Peerless Pump Company.
9. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rated for **175-psig** minimum working pressure and a continuous water temperature of **225 deg F**.

C. Pump Construction:

1. Casing: Radially split, cast iron, bronze fitted, with drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, **and threaded flanged or companion-flange connections.**
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. ~~For constant-speed pumps,~~ Trim impeller to match specified performance.
3. Pump Shaft:
   a. **Steel,** with oil lubricated copper-alloy shaft sleeve.
4. **Seal:** Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and **Buna-N** bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings:
   a. Oil lubricated, **bronze-journal**.

D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

   a. Enclosure: **Open, dripproof**.
   b. Enclosure Materials: **Cast iron**.
   c. **Motor Bearings: Grease-lubricated** ball bearings.
   d. Efficiency:
      1) Premium efficient.
   e. NEMA Design:
   f. Service Factor: 1.15

2.4 DOMESTIC WATER PUMPS

A. Casings and all wetted parts in pumps used in domestic water systems shall be **stainless steel**.

B. See Division 22 Section “Domestic Water Pumps”.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. **175-psig** pressure rating, **cast-iron** body and end cap, pump-inlet fitting.
3. Bronze startup and **bronze** or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. **Factory-fabricated** support.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

B. Comply with **HI 1.4**.

C. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

D. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

F. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in **Division 03 “Cast-in-Place Concrete.**"
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

G. **Equipment Mounting**: Install in-line pumps with continuous-thread hanger rods and spring hangers **elastomeric hangers** of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

A. **Engage a factory-authorized service representative to perform** alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Division 23 Section "Steam and Condensate Heating Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. **Install check, shutoff, and throttling** on discharge side of pumps.

E. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

F. Install **suction diffuser** and shutoff valve on suction side of vertical-inline and base-mounted pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

I. Install thermometers at pump suction and discharge.

J. Install check valve and gate or ball valve on each condensate pump unit discharge.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
   1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.
    b. Verify bearing lubrication.
    c. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    d. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
7. Open cooling water-supply valves if stuffing boxes are water cooled.
8. Open sealing liquid-supply valves if pumps are so fitted.
9. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
10. Open circulating line valves if pumps should not be operated against dead shutoff.
11. Start motor.
12. Open discharge valve slowly.
13. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
14. Check general mechanical operation of pumps and motors.
15. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

B. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.

3.6 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in maintenance manuals. Refer to Division 1 Section Contract Closeout.
4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 23 2123

SECTION 23 2500

HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following water treatment for closed-loop hydronic systems:

1. Manual chemical-feed equipment.
2. HVAC System cleaning and treatment Chemicals.
3. Chemical treatment test equipment.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:

1. Bypass feeders.
2. Chemical test equipment.
3. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to hydronic systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certificates: For components, from manufacturer.

1. Submit certification that the manufactured equipment and components will withstand seismic forces defined in Section 239548 “Vibration and Seismic Controls for HVAC”.
2. Basis for Certification: Indicate whether Withstand Certification is based on actual test of assembled components or on calculation.

    a. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to seismic forces specified

3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
2. Water Analysis: Illustrate water quality available at Project site.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities and applying water treatment as specified in this Section.

B. Mechanical Equipment Contractor: Responsibilities to include installation of water-treatment equipment under the direction of the HVAC Water-Treatment Service Provider (above).

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:

1. Initial and periodic water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. At quarterly intervals following Substantial Completion provide field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Power Engineering Co. (PECO)

2. Other than Power Engineering shall obtain written prior approval.

2.2 PERFORMANCE REQUIREMENTS

A. Water quality for hydronic systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of hydronic equipment without creating a hazard to operating personnel or the environment.

B. HVAC water treatment and cleaning formulated based on the water quality at Project site, hydronic system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, shall have the following water qualities:

1. Closed hydronic systems, including:

    a. Heating - hot-water system;
    b. Heating - glycol/water system;
    c. Cooling - chilled water system;
    d. Cooling - chilled glycol/water system;
    e. Dual-temperature water system;
    f. Snowmelt with glycol/water.

2. pH: Maintain a value within 8.8 to 9.5
3. Nitrite: Maintain a value within 800 to 1000 ppm.
4. Soluble Copper: Maintain copper coupon corrosion rates less than 0.20 mpy.
5. TDS: Maintain a maximum value of 3000 ppm
6. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
7. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/mL.
    b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/mL.
    c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL.
    d. Sulfate Reducers: Maintain a maximum value of zero (0) organisms/mL.
    e. Iron Bacteria: Maintain a maximum value of zero (0) organisms/mL.

2.3 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 2 gal.
2. Minimum Working Pressure: 125 psig

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing: total hardness drop, phosphate, sodium nitrate, for closed hydronic systems.

2.5 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Glycol Feed System:

1. One (1) 50-gallon polyethylene feed tank. Wall thickness shall be a minimum of ¼". Tank shall be mounted on a steel frame with accommodations for mounting a pump underneath. Tank shall be supplied with a removable lid and all interconnecting piping to pump including strainer and isolation valve. Tank height including stand shall not exceed 48". Tank stand shall be finished with an epoxy powder coating to protect against corrosion.
2. One (1) Level switch to deactivate pump and activate alarm on low glycol level in the feed tank.
3. One (1) Control panel shall house switching device for pump, audible alarm, HOA switch for pump, lights to indicate power and low level, pushbutton for alarm silence. Enclosure shall be NEMA 12. Control panel shall be mounted on the tank stand.
4. One (1) 1/3 HP centrifugal pump mounted under the feed tank. Materials of construction shall be bronze. Pump shall provide 2.5 GPM at 60 PSIG. Rotary gear pump is not acceptable.
5. One (1) Pressure switch shall be Honeywell L404F1078 or Square D 9012 GNG-4. Switch pressure at: [Field determine pressure to activate the glycol feed pump] [Field determine differential setting for the pressure switch.]

2.6 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Contractor Responsibilities:

1. Water Treatment Contractor:

    a. Provide water treatment equipment.
    b. Provide fluids,
    c. Chemicals.
    d. Make adjustments.

2. Mechanical Contractor:

    a. Install equipment per Water Treatment Contractors instructions.

B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install water testing equipment on wall near water chemical application equipment.

D. Install glycol feed system per manufacturers recommendations.

E. Bypass Feeders: Install in closed hydronic systems, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps unless otherwise indicated on Drawings.
2. Install full-port ball isolation valves on inlet, outlet, and drain below the feeder inlet.
3. Install a swing check on the inlet after the isolation valve.

F. Cleaning:

1. After completing system installation, inspect exposed finish. Remove burrs, dirt. And construction debris; repair damaged finishes, including chips scratches and abrasions.
2. Ensure system is operational, filled, started and vented prior to cleaning. Place terminal control valves in OPEN position during cleaning. Use water meter to record capacity of each system.
3. Add cleaning chemicals as recommended by manufacturer. Circulate for 48-hours, then drain. Refill with clean water and circulate for 24-hours, then drain. Refill with clean water and repeat until system cleaning chemicals are removed.

3.3 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance.

B. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Comply with requirements in Section 232116 "Hydronic Piping Specialties."

C. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General-Duty Valves for HVAC Piping."

D. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup-water connections to potable-water systems.

E. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of hydronic systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare written test and inspection reports. Include written reports with Close Out Submittals

E. At quarterly intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that manual chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Meet and consult with Owner’s maintenance personnel. Submit written reports of water analysis advising Owner of changes necessary to adhere to "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.
5. Copper: ASTM D 1688
6. pH: ASTM D 5464

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to adjusting, operating, startup and shutdown; troubleshooting; servicing and preventative maintenance of the HVAC Water Treatment Systems.

1. Review data in the Operation and Maintenance Manual. Refer to Division 1 Section “Contact Closeout”.
2. Schedule training with Owner through the Architect with at least 14 days advance notice.

END OF SECTION 23 2500

SECTION 23 3001

COMMON DUCT REQUIREMENTS

PART 1 - PRODUCTS

1.1 SUMMARY

A. Includes But Not Limited To:

1. General procedures and requirements for ductwork.
2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

B. Related Sections:

1. Division 07: Quality of Acoustic Sealant.
2. Section 23 0500: Common Work Results for HVAC
3. Section 23 0593: Testing Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

A. Samples: Sealer and gauze proposed for sealing ductwork.

B. Quality Assurance / Control:

1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
2. Specification data on sealer and gauze proposed for sealing ductwork.

1.3 QUALITY ASSURANCE

A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.

B. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

PART 2 - PRODUCTS

2.1 Finishes, Where Applicable: Colors as selected by Architect.

2.2 Duct Hangers:

A. One inch by **18 ga** galvanized steel straps or steel rods as shown on Drawings, and spaced not more than **96 inches** apart. Do not use wire hangers.

1. Attaching screws at trusses shall be **2 inch** No. 10 round head wood screws. Nails not allowed.
2. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 - ph-1. Double nut connection.

2.3 Penetration Soundproofing Materials:

A. Insulation for Packing: Fiberglass.

B. Calking: Polysulphide.

C. Escutcheon Frame: **22 ga** galvanized iron **2 inches** wide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:

1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

D. Penetration Soundproofing

1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of calking.
2. Provide calking at least **2 inches** thick between duct and structure on both ends of opening through structure.
3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION 23 3001

SECTION 23 3113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall **round** ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Section 230713 “Duct Insulation” for duct insulation and fire wrap.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and **vibration isolation.**
13. Duct fabrication shall not begin until shop drawings have been submitted and reviewed by the mechanical engineer.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. **Design Calculations: Calculations for selecting hangers and supports.**

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including, but not limited to the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to [**AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.**] [**AWS D1.2/D1.2M,**

"Structural Welding Code - Aluminum," for aluminum supports.] [**AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.**]

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Duct dimensions shown on drawings are inside clear dimensions.

E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

B. Duct dimensions shown on drawings are inside clear dimensions.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: **0.24 Btu x in./h x sq. ft. x deg F**at **75 deg F** mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: **0.25 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.

H. **Inner Duct:** Minimum **0.028-inch** perforated galvanized sheet steel having **3/32-inch-**diameter perforations, with overall open area of 23 percent. Inner duct shall be solid sheet steel a minimum of 10 feet downstream of humidifiers or air washers.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Duct dimensions shown on drawings are inside clear dimensions.

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for

static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than **60 Inches** in Diameter: Flanged.

D. Longitudinal Seams: Not allowed.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. Duct dimensions shown on drawings are inside clear dimensions.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Transverse Joints in Ducts Larger Than **60 Inches** in Diameter: Flanged.

2. Longitudinal Seams: Not allowed.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. **Inner Duct**: Minimum **0.028-inch** perforated galvanized sheet steel having **3/32-inch-**diameter perforations, with overall open area of 23 percent.

1. Inner duct shall be solid sheet steel a minimum of 10 feet downstream of humidifiers and/or air washers.

D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: **0.24 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: **0.25 Btu x in./h x sq. ft. x deg F**at **75 deg F** mean temperature.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: **G90**.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, **1/4-inch** minimum diameter for lengths **36 inches** or less; **3/8-inch** minimum diameter for lengths longer than **36 inches**.

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.
c. Knauf Insulation.
d. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: **0.24 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.
b. Type II, Rigid: **0.25 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Water-Based Liner Adhesive:
   a. Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

b. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Aeroflex USA Inc.
   b. Armacell LLC.
   c. Rubatex International, LLC

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

   a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, , length to suit depth of insulation indicated with integral **1-1/2-inch** galvanized carbon-steel washer.
   a. **0.135-inch-**diameter shank.
2. Insulation-Retaining Washers: With beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** in diameter.
   a. Self-locking washers formed from **0.016-inch-**thick **aluminum.**

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners **4 inches** from corners and at intervals not exceeding **12 inches**transversely; at **3 inches**from transverse joints and at intervals not exceeding **18 inches**longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.

8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: **3/32-inch** diameter, with an overall open area of 23 percent.

9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: **4 inches**.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: **10-inch wg**, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: **Minus 40 to plus 200 deg F**.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: **10-inch wg**, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.

6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: **10-inch wg**, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of **3 cfm/100 sq. ft. at 1-inch wg** and shall be rated for **10-inch wg** static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Rectangular Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

I. Straps:
1. Supports for exposed round ductwork.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install **round** ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of **2 inch**, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches.**

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. **Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines"** .

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 **ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD** EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of **12 feet** in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of **1-1/2 inches** from bottom of duct. [**20 feet**]

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

D. Perform a light test of grease ductwork per 2012 International Mechanical Code paragraph 506.3.2.5. prior to concealment by insulation or covered by shaft.

1. Perform light test in the presence of local Inspector/Engineer.
2. Document whether test passed or failed.
3. Repair any joints or duct welds that fail light test to the point the ductwork passes the light test.

E. Install grease duct with minimum clearance to combustibles as required by IBC and local codes. Installations that do not meet the minimum required clearances shall be fire wrapped as specified in Section 230713 “Duct Insulation”.

F. Provide approved fire-wrap insulation that meets ASTM C 656.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. **Outdoor, Exhaust Ducts: Seal Class A.**
4. **Outdoor, Return-Air Ducts: Seal Class A.**
5. **Outdoor, Return-Air Ducts: Seal Class [C.]**
6. **Unconditioned Space, Supply-Air Ducts in Pressure Classes** 2-Inch wg **and Lower: Seal Class A.**
7. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg**: Seal Class A.
8. **Unconditioned Space, Exhaust Ducts: Seal Class A.**
9. **Unconditioned Space, Return-Air Ducts: Seal Class A.**
10. **Conditioned Space, Supply-Air Ducts in Pressure Classes** 2-Inch wg **and Lower: Seal Class A.**
11. **Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than** 2-Inch wg**: Seal Class A.**
12. **Conditioned Space, Exhaust Ducts: Seal Class A.**
13. **Conditioned Space, Return-Air Ducts: Seal Class A.**

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches**thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches**thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within **24 inches** of each elbow and within **48 inches** of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of **16 feet**.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
   1. Comply with **ASCE/SEI 7**.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Supply Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      b. Return Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      c. Exhaust Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      d. Outdoor Air Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than **50 percent** of total installed duct area for each designated pressure class.

   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give **seven** days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Any liner showing evidence that is has wet at any time shall be removed and replaced with new liner.
   a. Disinfect affected sheet metal, and pins.
   b. Install new liner per specifications
   c. Seal friable edges and seams of repaired liner.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean **new** duct system before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with **99.97 percent** collection efficiency for **0.3-micron**-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.11 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Ductwork running in areas where there are no ceilings or when noted on the drawings shall be doubled wall duct and shall meet the requirements indicated below.

C. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

    a. Pressure Class: Positive **2-inch wg.**

    b. Minimum SMACNA Seal Class: **A**.
    c. Minimum SMACNA Seal Class: **A**.

    d. SMACNA Leakage Class for Rectangular: **16**.

    e. SMACNA Leakage Class for Round: **8**.

2. Ducts Connected to Constant-Volume Air-Handling Units:

    a. Pressure Class: Positive **3-inch wg.**

    b. Minimum SMACNA Seal Class: **A**.

    c. SMACNA Leakage Class for Rectangular: **8.**

    d. SMACNA Leakage Class for Round: **4**.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

    a. Pressure Class: Positive **6-inch wg.**

b. Minimum SMACNA Seal Class: **A**.

c. SMACNA Leakage Class for Rectangular: **4**.

d. SMACNA Leakage Class for Round: **2**.

4. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive **4-inch wg.**

b. Minimum SMACNA Seal Class: **A**.

c. SMACNA Leakage Class for **Rectangular**: **4.**

d. SMACNA Leakage Class for Round: **2**.

D. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative **2-inch wg.**

b. Minimum SMACNA Seal Class: **A**.

c. SMACNA Leakage Class for Rectangular: **16.**

d. SMACNA Leakage Class for Round: **8**.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative **2-inch wg.**

b. Minimum SMACNA Seal Class: **A**.

c. SMACNA Leakage Class for Rectangular: **16**.

d. SMACNA Leakage Class for Round: **8**

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative **3-inch wg.**

b. Minimum SMACNA Seal Class: **A**.

c. SMACNA Leakage Class for Rectangular: **8**.

d. SMACNA Leakage Class for Round: **4**.

E. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative **2-inch wg.**

b. Minimum SMACNA Seal Class: **A**.

c. SMACNA Leakage Class for Rectangular: **16.**

d. SMACNA Leakage Class for Round: **4.**

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative **3-inch wg.**

b. Minimum SMACNA Seal Class: **A.**

c. SMACNA Leakage Class for Rectangular: **8.**

d. SMACNA Leakage Class for Round: **4.**

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

a. Pressure Class: Positive **6-inch wg.**

b. Minimum SMACNA Seal Class: **A.**

c. SMACNA Leakage Class for Rectangular: **4.**

d. SMACNA Leakage Class for Round: **2.**

4. Ducts Connected to Type I (Grease) Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: 18 gauge Type 304, stainless-steel sheet, No. 4 finish.

b. Concealed: 16 gauge black steel.

c. Pressure Class: Positive or negative **3-inch wg**.

d. Welded seams and joints.
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: **2.**
g. A light test shall be performed for grease duct prior to concealing the duct.

5. Ducts Connected to Type II (Heat) Commercial Kitchen Hoods:

a. Type 304, stainless-steel sheet.

b. Exposed to View: No. 4 finish.

c. **Pressure Class: Positive or negative 3-inch wg.**

d. Concealed: No. 2D finish.
e. Welded seams and joints.
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: **2.**

6. Ducts Connected to Dishwasher and Low Temperature Vapor and Odor Hoods:

a. Type 304, stainless-steel sheet.

b. **Exposed to View:** No. 4 finish.

c. **Pressure Class:** Positive or negative **3-inch wg.**

d. Concealed: No. 2D finish.
e. Welded seams and flanged joints with watertight EPDM gaskets.
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations, flanged joints class A.
g. SMACNA Leakage Class: **2.**

7. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative **4-inch wg.**

b. Minimum SMACNA Seal Class: **A.**

c. SMACNA Leakage Class for Rectangular: **4 .**

d. SMACNA Leakage Class for Round: **2 .**

F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units**:**

a. Pressure Class: Positive or negative **2-inch wg.**

b. Minimum SMACNA Seal Class: **A.**

c. SMACNA Leakage Class for Rectangular: **16 .**

d. SMACNA Leakage Class for Round and Flat Oval: **4.**

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative **3-inch wg**.

b. Minimum SMACNA Seal Class: **A.**

c. SMACNA Leakage Class for Rectangular: **8.**

d. SMACNA Leakage Class for Round: **4.**

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative **3-inch wg.**

b. Minimum SMACNA Seal Class: **A.**

c. SMACNA Leakage Class for Rectangular: **8.**

d. SMACNA Leakage Class for Round: **4.**

G. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: **Galvanized steel.**

2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: **Match duct material**.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: **Match duct material**.

4. Aluminum Ducts: Aluminum.

H. Duct Liner Restrictions:

1. Duct Liner exposed to air movement shall not be used on medium pressure ductwork (2000 to 4000 FPM velocity). See section 230713 "Duct Insulation" for insulation requirements.

2. Duct Liner exposed to air movement shall not be used on high pressure ductwork (Greater than 4000 FPM velocity). See section 230713 "Duct Insulation" for insulation requirements.

3. All duct liner shall meet all of the requirements found in 2021 IECC

I. Liner: (Ductwork located Interior to building Insulated Envelope)

1. Low Pressure Supply Air Ducts (Less than 2000 FPM velocity): **Fibrous glass, Type I**, **1-1/2 inch** thick with a minimum R value of 6.0 for ducts in conditioned spaces.

2. Supply Air Ducts: **Fibrous glass, Type I** [**or flexible elastomeric] [Natural fiber]**, **1-1/2 inch** thick for ducts in conditioned spaces**.**

3. Return Air Ducts: **Fibrous glass, Type I**, **1-1/2 inch** thick with a minimum R value of 6.0 for ducts in conditioned spaces.

4. Return Air Ducts: **Fibrous glass, Type I** [**or flexible elastomeric] [Natural fiber]**, **1-1/2 inch** thick for ducts in conditioned spaces**.**

5. Exhaust Air Ducts: **Fibrous glass, Type I** [**or flexible elastomeric] [Natural fiber]**, **1 inch** thick**.**

6. Supply Fan Plenums: **Fibrous glass, Type I**, **1 inch** thick with a minimum R value of 4.0.

7. Return- and Exhaust-Fan Plenums: **Fibrous glass, Type II**, **1 inch** thick with a minimum R value of 4.0.

8. Transfer Ducts: **Fibrous glass, Type I** [**or flexible elastomeric] [Natural fiber]**, **1 inch** thick. **[1-1/2 inches] [2 inches].**

J. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.

2. Return Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.

3. Exhaust Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.

K. Exterior Ductwork Liner Insulation:

1. Supply Air Ducts: **2 inch** thick with a minimum R value of 8.0.

2. Return Air Ducts: **2 inch** thick with a minimum R value of 8.0.

3. Exhaust Air Ducts: **2 inch** thick with a minimum R value of 8.0.

L. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity **1000 fpm** or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity **1000 to 1500 fpm**: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity **1500 fpm** or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, **12 Inches** and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, **14 Inches** and Larger in Diameter: Welded.

M. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry high efficiency take-off.

b. Rectangular Main to Round Branch: 45-degree entry high efficiency take-off.

2. **Round**:

a. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
b. Velocity **1000 to 1500 fpm**: **45-degree entry high efficiency tap.**
c. Velocity **1500 fpm** or Higher: 45-degree lateral.

END OF SECTION 23 3113

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft dampers.
2. Pressure relief dampers.
3. Barometric relief dampers.
4. Manual volume dampers.
5. Control dampers.
6. Fire dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Duct silencers.
10. Turning vanes.
11. Remote damper operators.
12. Duct-mounted access doors.
13. Flexible connectors.
14. Flexible ducts.
15. Duct accessory hardware.
16. High efficiency take-offs.

B. Related Requirements:

1. Division 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 23 “Diffusers, Registers and Grilles”.
3. Division 28 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
4. Division 28 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, pressure relief-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to **10** percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653.
   1. **Galvanized Coating Designation: G60**.
   2. Exposed-Surface Finish: Mill phosphatized.

B. Aluminum Sheets: Comply with **ASTM B 209**, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

C. Extruded Aluminum: Comply with **ASTM B 221**, Alloy 6063, Temper T6.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

E. Tie Rods: Galvanized steel, **1/4-inch** minimum diameter for lengths **36 inches** or less; **3/8-inch** minimum diameter for lengths longer than **36 inches**.

2.3 BACKDRAFT DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. American Warming and Ventilating; a division of Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Pottorff.
   5. Ruskin Company.
   6. United Enertech

B. Function:
   1. Designed to allow airflow in one direction and prevent reverse airflow.
   2. Keeps outside air out of the space by sensing and closing against mass flow.

C. Description:
   1. Gravity balanced.

D. Maximum Air Velocity:
   1. **1000 fpm**

E. Maximum System Pressure:
   1. **3-inch wg**.

F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange:
   1. **16GA 0.063-inch- thick extruded aluminum.**

G. Blades: Multiple single-piece blades, maximum **6-inch** width noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges:
   1. Center pivoted: 16GA 0.050-inch- thick aluminum sheet.

H. Blade Action: Parallel.

I. Blade Seals: Mechanically locked.
   1. Neoprene.

J. Blade Axles: **0.20 inch** diameter:
1. **Material: Nonferrous metal**.
2. .

K. Tie Bars and Brackets:
1. Aluminum .

L. Return Spring: Adjustable tension.

M. Bearings:
1. Synthetic pivot bushings.

N. Accessories.

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: **20 gage** minimum.
    b. Sleeve Length: **6 inches** minimum.
4. Screen Mounting: Rear mounted.
5. Screen Material:
    a. Aluminum.
6. Screen Type:
    a. Bird
7. 90-degree stops.

2.4 PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

B. Function:
1. Provide component designed to protect HVAC systems by relieving air pressure from within a space that is beyond a pre-determined limit.
2. To automatically begin to open at a pre-set pressure difference above maximum system pressure.
3. Internally self-controlled with system pressure utilizing adjustable arms and weights.
4. Self-actuated with system pressure utilizing adjustable arms and weights.
5. Employs blade counterbalancing.
6. Automatically closes and re-sets when pressures return to normal conditions.

C. Air Velocity:
1. **3900 fpm**.

D. Maximum System Pressure (MSP):
1. 5-inch wg.

2. 4-inch wg.

E. Differential Pressure Preset above MSP:
1. 1-inch wg.

F. Maximum Damper Pressure Limit:
1. 5.0-inch wg.

G. Frame Material: Flanged Channel:
1. 14GA 0.079-inch- thick galvanized steel.

H. Frame Depth: **8-inch-** minimum.

I. Blades:
1. Material:
a. 16GA 0.063-inch- formed galvanized steel.
2. Type:
a. Formed Sheetmetal.
3. Blade-stop:
a. With stop.

J. Blade Action: Parallel.

K. Blade Seals:
1. Thermo Plastic Elastomer.

L. Blade Axles:

1. Material:
a. Plated steel.
2. Diameter: 0.375 inch.

M. Linkage:
1. External heavy duty type with galvanized steel clevis arms and plated steel tie bars & pivot pins with nylon pivot bearings.

N. Bearings:
1. Galvanized Steel ball.

2.5 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

B. Function:
1. Senses and compares outdoor ambient and indoor pressures.
2. Allows any higher pressure indoor air to escape.

C. Description: Suitable for horizontal or vertical mounting.

D. Maximum Air Velocity:
1. 1000 fpm

E. Maximum System Pressure:
1. 3-inch wg .

F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange.
1. **13GA 0.094-inch- thick, galvanized sheet steel**.

G. Blades: Multiple:
1. 16GA 0.050-inch- thick aluminum sheet.
2. aximum Width: **6 inches**.
3. Action: Parallel.
4. Balance: Gravity.
5. Pivot:
a. Eccentric.

H. Blade Seals:
1. Neoprene

I. Blade Axles:
1. Galvanized steel .

J. Tie Bars and Brackets: Rattle free with 90-degree stop.
1. Material:
a. Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings:
1. Synthetic

2.6 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Warming and Ventilating; a division of Mestek, Inc.
b. McGill AirFlow LLC.
c. Nailor Industries Inc.
d. Pottorff.
e. Ruskin Company.
f. United Enertech

2. Standard leakage rating **, with linkage outside airstream** .
3. Suitable for horizontal or vertical applications.

4. Frames: Hat-shaped, Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
a. 16GA 0.064-inch thick, galvanized sheet steel.

5. Blades:
   a. Multiple or single blade. Parallel- or opposed-blade design. Stiffened damper blades for stability.
   b. Material:
      1) Galvanized -steel, 16GA 0.064 inch thick.

6. Blade Axles:
   a. Nonferrous metal
   b. Shall extend full length of damper blades in ducts with pressure classes of **3-inch wg** or more.

7. Bearings:
   a. Material:
      1) Molded synthetic.
   b. Bearings at both ends of damper operating shafts in ducts with pressure classes of **3-inch wg** or more.

8. Tie Bars and Brackets: Galvanized steel.

B. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Warming and Ventilating; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. United Enertech

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating **, with linkage outside airstream,** and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:
   a. Frame: Hat-shaped,
      1) **16GA 0.064-inch** thick, galvanized sheet steel.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Material:
      1) Galvanized, roll-formed steel, 16GA 0.064 inch thick.

7. Blade Axles:
   a. Nonferrous metal.

8. Bearings:

   a. **Molded synthetic**.

b. Dampers in ducts with pressure classes of **3-inch wg** or more shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals:
   a. Neoprene.
10. Jamb Seals: Cambered **Stainless steel** or **aluminum**.
11. Tie Bars and Brackets: **Galvanized steel** or **aluminum**.
12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:

1. Size:
   a. 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of **3/32-inch-** thick zinc-plated steel, and a **3/4-inch** hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.7 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.
4. Young Regulator Company.
5. United Enertech

B. Low-leakage rating**, with linkage outside airstream,** and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Section:
   a. **Hat** shaped.
2. Material:
   a. 20 GA 0.40-inch- thick galvanized steel .
3. Corners:
   a. Mitered-and-welded.

D. Blades: Multiple.

1. Maximum blade width:
   a. 6 inches.

2. Opposed -blade design.
3. Material:
   a. Galvanized-steel.
4. Thickness:
   a. 20 GA 0.40-inch- thick galvanized steel
5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
   a. Closed-cell neoprene

E. Blade Axles:

1. Section:
   a. **3/8-inch-**square
2. Material:
   a. **Galvanized steel**.
3. Blade-linkage hardware:
   a. Zinc-plated steel and brass.
   b. Ends sealed against blade bearings:
4. Operating Temperature Range: From **minus 40 to plus 200 deg F**.

F. Bearings:

1. Type:
   a. Molded synthetic.
2. Axles: Dampers in ducts with pressure classes of **3-inch wg** or more shall have axles full length of damper blades.
3. Bearings: Thrust bearings at each end of every blade. Bearings at both ends of each operating shaft.

2.8 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arrow United Industries; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.
6. United Enertech

B. Type:
1. **Dynamic.**

C. Standard: Rated and labeled according to UL 555 by an NRTL.

D. Closing rating in ducts up to **4-inch wg** static pressure class and minimum **2000-fpm** velocity.

E. Fire Rating:
1. 1-1/2 hours.

F. Frame:
1. Curtain type with blades outside airstream.
2. Material:

a. Fabricated with roll-formed galvanized steel; with mitered and interlocking corners.
b. Thickness:
1) 20GA-0.040-inch-.

G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel. Length to suit application.

1. Minimum Thickness:
a. 18GA-0.05 inch, as indicated.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

H. Mounting Orientation: Vertical or horizontal as indicated.

I. Blades: Roll-formed, interlocking, galvanized sheet steel.
1. Thickness:
a. **24GA-0.024-inch-**
2. In place of interlocking blades, use full-length, **0.034-inch-** thick, galvanized-steel blade connectors.

J. Horizontal Dampers: Include blade lock and Type 301 constant force stainless-steel closure spring.

K. **Heat-Responsive Device:** Replaceable, **212 deg F** rated, fusible links.

2.9 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.
5. United Enertech

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

1. Type: Photoelectric.

D. Frame: Galvanized sheet steel. With or without mounting flange as required.
1. Thickness:
a. Hat-shaped, 16GA-0.064-inch.
2. Corners:
a. Welded.

E. Blades: Horizontal, galvanized sheet steel.
1. Section;
a. Roll-formed.
2. Fit:
a. Interlocking.
3. Thickness:

a. 14GA-0.079-inch.

F. Leakage:
1. Class II.

G. Seals:
1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of **450 deg F** .

H. Rated pressure and velocity to exceed design airflow conditions.

I. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
1. Minimum **17-inches** long.
2. Thickness:
a. **0.05-inch-**.

J. Damper Motors:
1. Action:
a. Two-position
2. Mode: Fail close.
3. Mounting: External.

K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Electrical Connection: **115 V, single phase, 60 Hz** .

L. Accessories:

1. Auxiliary switches for signaling:
a. Position indication.
2. Test Switch type:
a. Momentary test switch.
3. Test Switch Mounting:
a. Damper.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.
5. United Enertech

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to **4-inch wg** static pressure class and minimum velocity of:
1. **4000-fpm**

D. Fire Rating:

1. 1-1/2 hours.

E. Frame: Hat shaped, galvanized sheet steel. With or without mounting flange as required.
1. Thickness:
a. 16GA-0.064-inch
2. Corners:
a. Welded.

F. **Heat-Responsive Device:** Replaceable, **212 deg F** rated, fusible links.

G. Blades: Horizontal, galvanized sheet steel.
1. Type:
a. Air-foil.
2. Fit:,
a. Interlocking.
3. Thickness:
a. 0.063-inch-.

H. Leakage:
1. Class I.

I. Rated pressure and velocity to exceed design airflow conditions.

J. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
1. Thickness:
a. **18GA 0.05-inch-**.

K. Master control panel for use in dynamic smoke-management systems.

L. Damper Motors:
1. Locate outside air stream unless otherwise indicated,
2. Action:
a. Two-position.
3. Voltage: to match fire alarm system (coordinate).
4. Listed: UL, as part of damper assembly.
5. Outdoor Motors and Motors in Outside-Air Intakes:
a. Gaskets: O-ring gaskets designed to make motors weatherproof.
b. Internal heaters: Equip to permit normal operation at minus **40 deg F** .

M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Electrical Connection: 115 V, single phase, 60 Hz.

N. Accessories:

1. Auxiliary switches:
a. Signaling.
b. Position indication.
2. Test Switch type:
a. Momentary test switch.
3. Test Switch Mounting:
a. Damper.

2.11 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Industrial Acoustics Company.
2. Ruskin Company.
3. SEMCO Incorporated.
4. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: Galvanized sheet steel.
1. ASTM A 653:
   a. G60.
2. Thickness:
   a. 22GA-0.034 inch.

E. Round Silencer Outer Casing: Galvanized sheet steel.
1. ASTM A 653:
   a. **G60**.

2. Sheet Metal Thickness for Units up to **24 Inches** in Diameter: **22GA-0.034 inch** thick.
3. Sheet Metal Thickness for Units **26 through 40 Inches** in Diameter: **20GA-0.040 inch** thick.
4. Sheet Metal Thickness for Units **42 through 52 Inches** in Diameter: **18GA-0.05 inch** thick.
5. Sheet Metal Thickness for Units **54 through 60 Inches** in Diameter: **16GA-0.064 inch** thick.

F. Inner Casing and Baffles: Galvanized sheet metal with **1/8-inch-** diameter perforations.
1. ASTM A 653:
   a. **G60**.
2. Thickness:
   a. 22GA-**0.034 inch**.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss to achieve **STC 45**.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.

2. Dissipative or Film-lined type with fill material:

a. **Fill Material:** Inert and vermin-proof fibrous material, packed under not less than 15 percent compression
b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
c. Prohibited: Mineral wool will not be permitted as a substitute for glass fiber.

3. Lining:
a. Material:
1) Tedlar
b. Prohibited: Mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Joints:
a. Lock formed and sealed.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.
4. Structural Criteria: The silencers shall not fail structurally when subjected to a differential air pressure of **8 inches** water gage.
5. Spot Welds: All spot welds shall be painted.

K. Accessories:

1. Integral [**1-1/2**] [**3**]-hour fire damper with access door. **Access door to be high transmission loss to match silencer.**
2. Factory-installed end caps to prevent contamination during shipping.
3. Removable splitters.
4. Airflow measuring devices.

2.12 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. METALAIRE, Inc.
2. SEMCO Incorporated.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."

2. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction:
1. **Single** wall

F. Vane Spacing:
1. 1-1/2” spacing between turning vanes
2. 3-1/4” spacing not allowed.

G. Vane Construction: Single wall for ducts up to 36 **inches** wide and additional bracing for larger dimensions.

2.13 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff.
2. Ruskin Company; Tomkins PLC.
3. Young Regulator Company.

B. Cable Type:
1. Description: Cable system designed for remote manual damper adjustment.
2. Tubing/Sheathing: Galvinsed, Brass, Copper or Aluminum.
3. Cable: Stainless steel or Steel.
4. Wall-Box Mounting: Coordinate with Architect.
5. Wall-Box Cover-Plate Material: Coordinate with Architect.

C. Activated Electric Type:
1. Description: Electrically activated zone control damper for remote adjustment. When an adjustment is needed the system is powered up.
2. Means: Factory mounted actuator factory wired to damper.
3. Portable **9 volt** system. No field power requirement.
4. Mounting: Recessed Wall Box or Diffuser or Hand Held.
5. Wall-Box Cover Finish: Coordinate with Architect.
6. Wall-Box Porting: 1 to 6 ports or more.

2.14 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. McGill AirFlow LLC.
3. Pottorff.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

5. Ruskin Company

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures **7-2**, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: **1-by-1-inch** butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

   a. Access Doors Less Than **12 Inches** Square: No hinges and two sash locks.
   b. Access Doors up to **18 Inches** Square:
      1) Hinges:
         a) Two hinges and two sash locks.
   c. Access Doors up to **24 by 48 Inches**, provide outside and inside handles:
      1) Hinges:
         a) Three hinges and two compression latches.
   d. Access Doors Larger Than **24 by 48 Inches**, provide outside and inside handles:
      1) Hinges:
         a) Continuous and two compression latches with outside and inside handles.

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Ventfabrics, Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a wide fabric strip attached to two narrower metal strips. Provide strips of metal compatible with connected ducts.
1. Wide Strip:
   a. 3-1/2 inches.
2. Narrow Strips:
   a. 0.028-inch- thick, galvanized sheet steel.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: **26 oz./sq. yd.**.

2. **Tensile Strength**: **530 lbf/inch** in the warp and **440 lbf/inch** in the filling.
3. Service Temperature: **Minus 40 to plus 200 deg F**.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: **24 oz./sq. yd.**.
2. Tensile Strength: **530 lbf/inch** in the warp and **440 lbf/inch** in the filling.
3. Service Temperature: **Minus 50 to plus 250 deg F**.

2.16 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Themaflex
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181).

C. Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.

D. Insulated, Flexible Duct: Two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: **10-inch wg** positive and **1.0-inch wg** negative.
2. Maximum Air Velocity: **4000 fpm**.
3. Temperature Range: **Minus 10 to plus 160 deg F**.
4. Insulation R-value: **Comply with ASHRAE/IESNA 90.1**.

E. Flexible Duct Connectors:

1. **Clamps**: in sizes **3 through 18 inches**, to suit duct size.
   a. **Material**: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action.

2.17 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

C. Splitter Damper Accessories: Zinc-plated damper blade bracket; **1/4-inch**, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes **3 to 18 inches** to suit duct size.

2.22 HIGH EFFICIENCY TAKE-OFFS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Air-Rite
2. Hercules Industries
3. Sheet Metal Connectors, Inc.
4. Spiral Manufacturing Co. Inc.
5. Ferguson

B. Materials:

1. 24 gauge galvanized sheet metal meeting ASTM A653 and A924

C. Take-off shall meet SMACNA third edition Section 4.8 figure 4.6 - 45 degree entry.

D. Rectangular opening with flanged sides on all sides. Complete with closed cell neoprene gasket to provide a tight seal.

PART 3 - EXECUTION

3.1 INSTALLATION

General

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Use the Remote Damper Operator when they are called out on the drawings or when the damper cannot be easily accessed.

D. Install high efficiency take-off on all branch duct take-offs. Provide take-off with balancing damper as shown on drawings. Spin-in fittings are not allowed.

Flexible Ducts / Flexible Duct Connectors

E. Install flexible connectors to connect ducts to equipment.

F. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ductwork shall only be used as indicated on the drawings.

G. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air.

H. Flexible ductwork shall be run in straight lengths.

I. Provide support in flexible duct every three feet.

J. Flexible ducts shall have compression fittings on both ends.

K. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet-metal hard elbows. Hard turns, offsets, or kinks will not be allowed.

L. Flexible ducts shall connect to trunk duct with high efficiency takeoffs.

M. Connect flexible ducts to metal ducts with **draw bands**.

N. Connect ducts to duct silencers:
1. With flexible duct connectors.

O. Connect terminal units to supply ducts:
1. With maximum 12-inch lengths of flexible duct.

P. Do not use flexible ducts to change directions.

Q. Connect diffusers or light troffer boots to ducts:
1. **With maximum 60-inch** lengths of flexible duct clamped or strapped in place.

Backdraft/Control/Pressure Relief Dampers

R. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

S. Install pressure relief damper immediately upstream of main fire damper.

Volume Damper

T. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

U. Set dampers to fully open position before testing, adjusting, and balancing. Exception: Pressure relief damper.

V. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.

Fans And Test Holes

W. For fans developing static pressures of **5-inch wg** and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

X. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of **1/4-inch** movement during start and stop of fans.

Y. Install duct test holes where required for testing and balancing purposes.

Z. Install test holes at fan inlets and outlets and elsewhere as indicated.

FIRE, SMOKE AND FIRE-SMOKE DAMPERS

AA. Install fire **and smoke** dampers according to UL listing.
1. Install fusible links in fire dampers.

BB. For round ductwork **24-inch** and smaller a true round fire damper with the same rating may be used.

Access Doors

CC. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On upstream side of duct coils.
2. **Upstream** from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be **standard access doors** and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum **50-foot** spacing.
8. **Upstream** from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

DD. Install access doors with swing against duct static pressure.

EE. Access Door Sizes:

1. One-Hand or Inspection Access: **8 by 5 inches**.
2. Two-Hand Access: **12 by 6 inches**.
3. Head and Hand Access: **18 by 10 inches**.
4. Head and Shoulders Access: **21 by 14 inches**.
5. Body Access: **25 by 14 inches**.
6. Body plus Ladder Access: **25 by 17 inches**.

FF. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233300

SECTION 233423

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Centrifugal roof ventilators.
   2. Axial roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on:
   1. Actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

C. Fan Schedule: Fan characteristics and performance data are described in an equipment schedule on the drawings including:
   1. Fan arrangement with wheel configuration, inlet and discharge configurations, and required accessories.
   2. Capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, shipping weights, operating weights, operating characteristics, and furnished specialties and accessories. Also include the following:

   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
   a. Detail all wiring systems and differentiate clearly between manufacturer-installed and field-installed wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control Reports

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Power ventilator electrical components shall comply with applicable NEMA standards.

D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

E. TUV Certified: High Volume low speed fan shall comply with UL 507

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 PRODUCTS FURNISHED BUT NOT INSTALLED

A. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans. Roof curbs to be installed by Division 07, section "Roof Accessories".

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent; a division of Twin City Fan Companies, Ltd.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Twin City.

B. Housing: Removable: Square, one-piece, aluminum base with venture inlet cone.

1. Spun-aluminum, dome top and outlet baffle.
2. **Hinged Subbase**: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels:
1. Aluminum hub and wheel with backward-inclined blades.
2. Spark-Resistant Construction: AMCA 99, Type **A**

D. Direct-Drive Units: Motor mounted outside of airstream within fan housing.

E. Belt-Driven Units: Motor mounted on adjustable base, adjustable sheaves and with motor and belts within fan housing.

F. Accessories:
1. Disconnect Switch: Nonfusible type:
   a. Thermal-overload protection; factory wired through an internal aluminum conduit.
      1) Mounted inside fan housing.
2. Bird Screens: Removable, **1/2-inch** mesh:
   a. Aluminum wire.
3. Dampers:
   a. Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops**.**

b. **Motorized parallel-blade** dampers mounted in curb base with electric actuator; wired to close when fan stops**.**

G. Roof Curbs: Galvanized steel; mitered and welded corners; **1-1/2-inch** thick, rigid, fiberglass insulation adhered to inside walls; and **1-1/2-inch** wood nailer. Size as required to suit roof opening and fan base. Provide neoprene gasket between fan base and curb to reduce sound transmission.

1. Configuration:
   a. Self-flashing without a cant strip, with mounting flange.
2. Overall Height:
   a. 14 inches.
   b. 18 inches.

H. KITCHEN CENTRIFUGAL UPBLAST EXHAUSTERS
1. Spark-Resistant Construction: AMCA 99, Type **A**
2. Refer to Division 23 Section "Motors" for general requirements for factory-installed motors.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Enclosure Type: Totally enclosed;
1. Fan cooled

2.4 FACTORY FINISH

A. Metal Parts: All assembly parts shall be protected from rust and corrosion.
1. Stainless steel, aluminum, and other non-corroding materials require no protective finish.
2. Non-galvanized sheet metal parts shall be prime coated or powder coated before final assembly.
3. Prime coated parts shall receive baked enamel finish coat after assembly.

2.5 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

3.3 INSTALLATION

A. Install power ventilators level and plumb according to manufacturer's written instructions.

B. Base Mounted Equipment:

1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in:
   a. Division 33 "Cast-in-Place Concrete."

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. **Support Steel:** Support suspended units from structure using threaded steel as specified in Division 23 "Vibration and Seismic Controls for HVAC."

F. Label units according to requirements specified in Division 23 "Identification for HVAC Piping and Equipment."

G. Install power ventilators with factory recommended and code required clearances for service and maintenance.

3.4 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."
1. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.7 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."

C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION 233423

SECTION 233600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Shutoff, single-duct air terminal units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.
4. Seismic-restraint devices.

B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams:
   a. For power, signal, and control wiring.
   b. Differentiate between manufacturer-installed and field-installed wiring.
3. **Hangers and supports**, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. **Design Calculations:** Calculations, **including analysis data signed and sealed by the qualified professional engineer responsible for their preparation** for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Size and location of initial access modules for acoustic tile.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Air terminal units shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Powered-Unit Filters: Furnish **one** spare filter for each filter installed.

1.8 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

B. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

C. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

D. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

E. Comply with NFPA 70 for electrical components and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. **Structural Performance:** Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" .

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anemostat Products; a Mestek Company.
2. Carnes.
3. Environmental Technologies, Inc.
4. Krueger.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Price Industries.
8. Titus.
9. Trox USA Inc.; a subsidiary of the TROX GROUP.
10. Tuttle & Bailey.
11. Warren Technology.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. **Casing: 0.034-inch steel, single** wall.
1. **Casing Lining:** Adhesive attached, **coated, fibrous-glass duct liner** complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
   a. Lining thickness:
      1) **1/2-inch-**
   b. Cover liner with nonporous foil.
2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Air Outlet: S-slip and drive connections **size matching inlet size**.
5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage:
   a. ARI 880 rated, **3** percent of nominal airflow at **3-inch wg** inlet static pressure.
2. Damper Position:
   a. Normally **open**.

E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**, and rated for a minimum working pressure of **200 psig** and a maximum entering-water temperature of **220 deg F**. Include manual air vent and drain valve.

L. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Section 230900 "Instrumentation and Control for HVAC" and shall have the following features:

1. Damper Actuator: 24 V, powered closed, spring return open.

2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

   a. Occupied and unoccupied operating mode.
   b. Remote reset of airflow or temperature set points.
   c. Adjusting and monitoring with portable terminal.
   d. Communication with temperature-control system specified in Section 230900 "Instrumentation and Control for HVAC."

3. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

F. Control Sequence:

1. Suitable for operation with duct pressures between **0.25- and 3.0-inch wg** inlet static pressure.
2. System-powered, wall-mounted thermostat.

2.4 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. **Steel Cables: Galvanized steel complying with ASTM A 603**.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

D. Install discharge air temperature sensors at the outlet of each Air Terminal Unit.

E. Connect ductwork to air terminals according to Division 23 ductwork Sections.

F. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."

G. For Diffuser Type Air Terminal Units, provide and install all necessary control wiring and control voltage transformer. See drawings AND schedules for additional information.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than **4 inches** thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than **4 inches** thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Connect ducts to air terminal units according to **Section 233113 "Metal Ducts.**

D. Electrically ground all equipment:
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. **Testing Agency**: **Owner will engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Cleaning:

1. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.6 STARTUP SERVICE

A. **Engage a factory-authorized service representative to perform** startup service.

1. Complete installation and startup checks according to:
   a. Manufacturer's written instructions.
   b. Construction documents.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain air terminal units:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
2. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections:

1. Section 233714 "Fixed Louvers" for fixed and louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
3. Section 230594 "General Testing, Adjusting and Balancing" for balancing diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Factors
2. Carnes.
3. Kruegar.
4. METALAIRE, Inc.
5. Nailor Industries Inc.
6. Price Industries.
7. Titus.
8. Tuttle & Bailey.
9. Air Concepts.
10. Trox.

2.2 REGISTERS, GRILLES, & DIFFUSERS

A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type. See drawings AND schedules for additional information.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, coordination drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 233714

FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, **extruded-aluminum** louvers.

B. Related Requirements:

1. Section 099113 "Exterior Painting" for field painting louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to **ASCE/SEI 7.**

1. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.
2. Component Importance Factor: **1.0**.

B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airolite Company, LLC (The).
b. Pottorff.
c. Ruskin Company; Tomkins PLC.

2. Louver Performance Ratings:

a. Free Area: Not less than **8.5 sq. ft.** for 48-inch- wide by 48-inch- high louver.
b. Point of Beginning Water Penetration: Not less than **1250 fpm.**
c. Air Performance – **intake:** Not more than **0.10-inch wg** static pressure drop at **900-fpm** free-area velocity.
d. Air Performance – **exhaust**: Not more than **0.15-inch wg** static pressure drop at **1000-fpm** free-area velocity.

3. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: **Bird screening.**

B. Secure screen frames to louver frames with **machine screws with heads finished to match louver,** spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. **Reinforce extruded-aluminum screen frames at corners with clips.**
2. Finish**: Same finish as louver frames to which louver screens are attached**
3. Type: **Rewirable frames with a driven spline or insert**

D. Louver Screening for Aluminum Louvers:

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.
1. Contractor shall use **or hex-head or** screws for exposed fasteners screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: **Channel** unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Join frame members to each other and to fixed louver blades with fillet welds **concealed from view** unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Color Anodic Finish: AAMA 611, or thicker.
1. Color: **As selected by Architect from full range of industry colors and color densities**.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: **As selected by Architect from manufacturer's full range**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather-tight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 233714

SECTION 235100

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Listed **double**-wall **vents**.

2. POSITIVE PRESSURE FLUES
   a. Listed:
      1) **Double**-wall **vents**.
   b. Field-fabricated metal breechings.

3. CATEGORY IV, CONDENSING BOILERS, SPECIAL GAS VENTS
   a. Listed:
      1) **Double**-wall **vents**.
   b. This section specifies:
      1) Category IV vents/chimneys.
      2) Special Gas Units.
      3) Condensing Boilers – positive pressure.

B. Related Sections include the following:

1. Section 235113 "Draft Control Devices" for induced-draft and mechanical fans and for motorized and barometric dampers.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Chimney liners.
2. Type B and BW vents.
3. Type L vents.
4. Special gas vents. (Category IV, Condensing Boilers, Special Gas Vents).
5. Building-heating-appliance chimneys. (Forced Draft Boilers) .
6. Grease ducts.
7. Refractory-lined metal breechings and chimneys.
8. Guy wires and connectors.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer **Seismic** Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand **seismic** forces defined in Section 230548 "Vibration and Seismic Controls for HVAC." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the **seismic** forces specified."
    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the **seismic** event."

2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

D. Verification: Flue type to be verified by the boiler manufacturer of the submitted boiler.

1.6 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in **Division 07**.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: To cover the following number of years from date of Substantial Completion:
   a. 10 years.

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ampco.
2. Cleaver-Brooks.
3. Metal-Fab, Inc.
4. Schebler Co. (The).
5. Selkirk Corporation; Selkirk Metalbestos and Air Mate.
6. Simpson Dura-Vent Co., Inc.
7. Van-Packer Company, Inc.

B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B, or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

D. Inner Shell:
   1. ASTM B 209, Type 1100 aluminum

E. Outer Jacket:
   1. Galvanized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.
2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.
4. Termination: Antibackdraft.

2.2 LISTED SPECIAL GAS VENTS (POSITIVE PRESSURE FLUES)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Duravent
2. Heat-Fab, Inc.
3. Z-Flex; a division of the Novaflex Group.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.

C. Vent shall be factory-built special gas type, double wall, engineered and designed for use on Category IV appliances, or as specified by the equipment manufacturer.

D. Maximum continuous flue gas temperature not to exceed 550° F for gas burning appliances.

E. Construction: Inner conduit and outer wall casing shall be constructed with a one-inch air space between them and in such a fashion that prevents cross-alloy contamination. Optional 1" fiber insulation is available to maintain higher flue temperatures, but does not reduce clearances beyond the standard clearances tested for 1" air space model CI Plus.

F. Inner Shell: Vent shall be constructed with an inner conduit constructed of ASTM A 959, Type 29-4C or 2904 superferritic stainless steel with a minimum thickness of 0.015" for diameters of 3"to 8", 0.20" for diameters of 10" to 16", 0.025 for diameters 18" to 24", and 0.035" for 26" and greater.

G. Outer Jacket: The outer wall casing shall be constructed of 430 stainless steel that shall not require additional surface preparation, such as painting, in order to withstand the outdoors or high humidity environments.

H. The joint closure shall be an inner wall mechanical locking strap design. Joints shall not use screws or fasteners that penetrate the inner conduit.

I. General Electric RTV105 or Down Corning 736 high temperature sealant shall be used to seal all joints on systems where the maximum flue gas temperature will not exceed 550° F or a factory installed 550° F compatible silicone rubber gasket shall be used to seal joints.

J. Vent shall be listed for an internal static pressure of 15" w.g. and tested to 37" w.g.

K. Vent shall be constructed with a factory installed gasket used to seal the joint for diameters 4" to 16". Use of gasket lube, available from the factory, should be used for maximizing gasket life and ease of installation. For diameters 18" to 32", joints shall be sealed with factory supplied RTV sealant.

L. Tees and elbows shall provide a pressure drop less than 15 feet equivalent horizontal vent.

M. Fittings that increase or decrease vent diameter shall be asymmetric in construction with a flat wall that maintains a straight line with adjoin parts in order to facilitate the unobstructed flow of all condensate.

N. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.
2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
3. Termination: Exit cone with drain section incorporated into riser.

O. All parts shall be compatible with other single wall and double wass products of the same manufacturer.

P. System is to be sized in accordance with the appliance manufacturer's specifications, NFPA 54 National fuel Gas Code (ANSI Z223.1), ASHREA recommendations, and other applicable codes.

2.3 FIELD-FABRICATED METAL BREECHINGS AND CHIMNEYS

A. Fabricate freestanding chimneys according to SMACNA's "Guide for Steel Stack Design and Construction." (See Drawings for Dimensions).

B. Fabricate breechings and chimneys from ASTM A 1011/A 1011M hot-rolled steel with continuously welded joints, complying with NFPA 211 for minimum metal thickness.

1. Equal to or Less Than 1.069 Sq. Ft. or 14 Inches in Diameter: 0.053 inch.
2. Up to 1.396 Sq. Ft. or 16 Inches in Diameter: 0.067 inch.
3. Up to 1.764 Sq. Ft. or 18 Inches in Diameter: 0.093 inch.
4. Larger Than Above: 0.123 inch.

C. Fabricate chimneys and vent connectors from galvanized steel, complying with NFPA 211 for minimum metal thickness.

1. Equal to or Less Than 6 Inches in Diameter: 0.019 inch.
2. Up to 10 Inches in Diameter: 0.024 inch.
3. Up to 16 Inches in Diameter: 0.029 inch.
4. Larger Than Above: 0.056 inch.

D. Fabricate chimneys and vent connectors from ASTM B 209, Type 1100 or 3003, aluminum or stainless steel, complying with NFPA 211 for the following minimum metal thicknesses:

1. Aluminum: 0.027 inch.
2. Stainless Steel: 0.012 inch.

E. Fabricate cleanout doors from compatible material, same thickness as breeching, bolted and gasketed.

A. Fabricate engine exhaust:

1. From ASTM A 53, Type E (electric-resistance welded), Grade B; or ASTM A 106, Type S, Grade B, pipe;
   a. Schedule 40.

2. With welded joints and carbon-steel fittings and flanges.

3. With wrought-Steel Fittings: ASME B16.9, wall thickness to match adjoining pipe.
4. With wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, including bolts, nuts, and gaskets.

2.4 GUYING AND BRACING MATERIALS

A. Cable: **Three** galvanized, stranded wires of the following thickness:

1. Minimum Size: 1/4 inch in diameter.

2. For ID Sizes 4 to 15 Inches: 5/16 inch.
3. For ID Sizes 18 to 24 Inches: 3/8 inch.
4. For ID Sizes 27 to 30 Inches: 7/16 inch.
5. For ID Sizes 33 to 36 Inches: 1/2 inch.
6. For ID Sizes 39 to 48 Inches: 9/16 inch.
7. For ID Sizes 51 to 60 Inches: 5/8 inch.

B. Pipe: **Two** galvanized steel, NPS 1-1/4.

C. Angle Iron: **Two** galvanized steel, 2 by 2 by 0.25 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances.

B. Listed Special Gas Vent: Condensing gas appliances.

C. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.

D. Field-Fabricated Metal Breechings and Chimneys: Dual-fuel boilers, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

E. Field-Fabricated Metal Breechings and Chimneys: Steel pipe for use with engine exhaust.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

3.4 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS AND CHIMNEYS

A. Suspend breechings and chimneys independent of their appliance connections.

B. Install, support, and restrain according to seismic requirements.

C. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch misalignment tolerance.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. Support breechings and chimneys from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps, or beam clamps according to manufacturer's written instructions.

3.5 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 23 5216

CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes natural gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

B. Division 23 shall arrange and pay for State of Utah Boiler inspection and Inspection Certificate.

1.3 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, and Appendix N.

E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to Authority Having Jurisdiction (AHJ).

F. Mounting Base: For securing boiler to concrete base.

1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.

2. Include rated capacities, operating characteristics, and furnished specialties and accessories. Capacity values shall be de-rated based on the project altitude.

B. Shop Drawings: For boilers, boiler trim, and accessories.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include boiler flue and combustion air duct schematic drawing showing all flue and duct sizes, lengths, fittings and terminations based on field measurement of actual conditions.

C. Draft Analysis: Factory boiler flue and combustion air duct Draft Analysis based on the shop drawings using actual sizes, lengths and fittings; and the project altitude.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For chillers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on:

a. Test of assembled components by a nationally recognized testing standard procedure, such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demand determined by Section13.3 of ASCE 7.
b. An engineering analysis conforming to the requirements of Chapter 13 of ASCE 7.
c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports.

1. Factory burner and hydrostat tests.
2. Factory inspections and testing done in accordance with 2010 ASME Boiler and Pressure Vessel Code

C. Field quality-control reports.

1. Start checklists and testing performed by Factory-Authorized Service Representative.
2. Performance testing performed by Factory-Authorized Service Representative.

D. Sample Warranty: For special warranty.

E. Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers:

a. Leakage and Materials: ten (10) years from date of Substantial Completion.
b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Non-prorated for five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AERCO International, Benchmark Series.
2. Fulton, Vantage Series (2.0 to 6.0 MMBH)
3. Cleaver Brookes, Clear Fire

2.2 FORCED-DRAFT, FIRE-TUBE CONDENSING BOILERS

A. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.

B. Heat Exchanger: Stainless Steel, corrosion-resistant combustion chamber.

C. Burner: Natural gas, forced draft.

D. Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.

1. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

E. Gas Train: Control devices and modulating control sequence shall comply with ASME CSD-1 requirements.

F. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

G. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Powder-coated protective finish.
4. Insulation: Minimum 2-inch thick, polyurethane-foam insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.

H. Capacities and Characteristics:

1. Comply with the pressures, temperatures, flow rates, efficiencies and electrical characteristics as scheduled in the project Plans.

2.3 TRIM

A. Include devices sized to comply with ASME B31.1.

B. Aquastat Controllers: Operating**,** firing rate**,** and high limit.

C. Safety Relief Valve: ASME rated, pressure rating as scheduled on Drawings.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges, so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS-3/4 ball valve with hose-end and cap.

G. Condensate Trap: Provided by manufacturer.

H. Condensate Neutralization Tank: Provide by manufacturer with limestone chips.

2.4 CONTROLS

A. Refer to Section 230900 "Building Automation System" and Section 230993 "Sequence of Operations."

B. Boiler Management System: microprocessor based complete integrated system to control operations and energy input into the boiler plant. The boiler management system may be integrated into each boiler OR may be a standalone controller mounted separate from the boilers.

1. Sequencing Capability: 2 to 8 boilers to meet system load.
2. Boiler Operation: Automatically rotate lead/lag among the boilers on system; monitor run hours per boiler; and balance load to maintain equalize boiler run hours.
3. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
4. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.

5. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
6. Control wiring: Control wiring per the manufacturer's written instructions shall be by the Controls Contractor, refer to Section 230900 "Building Automation System".

C. Building Automation System (BAS) Interface: Factory installed hardware and software to enable the BAS to remotely monitor, control, and display boiler status and alarms from a BAS operator workstation.

1. Hardwired Points:

   a. Monitoring: On/off status**,** trouble alarms and low-water-level alarm.
   b. Control: Enable/disable operation and hot-water-supply temperature set-point adjustment (with 4-20 ma signal from the BAS).

2. Communication: LONworks or BACnet (ASHRAE 135)
3. Controlled Features:

   a. Alarms and alarm history.
   b. Monitored points displayed locally at boiler control panel shall be available through BAS.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to fused disconnect switch.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Refer to "Special Gas Vent" requirements Section 235100 "Breechings, Chimneys, and Stacks".

B. Kit: Complete Category IV (positive pressure, fully condensing) system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and neutralization tank, and sealant.

C. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations based on the provided equipment before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment bases. Concrete equipment bases shall comply with overall size, thickness, and edge distance for anchor bolts required in Section 230548 “Vibration and Seismic Controls” Submittal.
2. Equipment Bases: Comply with requirements specified in Section 033053 "Miscellaneous Cast-in-Place Concrete".
3. Vibration Isolation and Seismic Control: Comply with requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install field-mounted equipment (condensate traps, condensate neutralization tanks, etc.) furnished with the boiler but factory mounted.

D. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve.

E. Connect piping to boilers mounted on vibration isolators, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."

F. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.

G. Connect hot-water piping to supply and return boiler tapings with shutoff valve and union or flange at each connection.

H. Install piping from safety relief valves to nearest floor drain.

I. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
2. Connect full size to boiler connections.
3. Comply with “Special Gas Vent” requirements in Section 235100 "Breechings, Chimney and Stacks"

J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Boiler will be considered defective if it does not pass tests and inspections.

D. Prepare written test and inspection reports, with findings and corrective actions. Submit written report to Architect.

E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.

F. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
7. Notify Architect 10 days minimum in advance of test dates.
8. Document test results in a written report submitted to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance of boilers.

1. Review data in the Operation and Maintenance Manual. Refer to Division 1 Section “Contract Closeout”.
2. Schedule training with Owner through Architect with at least 10-days advance notice.

END OF SECTION 23 5216

SECTION 235700

HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes **gasketed-plate** heat exchangers.

1.3 DEFINITIONS

A. TEMA: Tubular Exchanger Manufacturers Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Tube-removal space.
2. Structural members to which heat exchangers will be attached.

B. Source quality-control reports.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For heat exchangers to include in emergency, operation, and maintenance manuals.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of domestic-water heat exchangers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including heat exchanger, storage tank, and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

    a. Plate, Domestic-Water Heat Exchangers:

        1) Brazed-Plate Type: **One** year.
        2) Plate-and-Frame Type: **One** year.

PART 2 - PRODUCTS

2.1 GASKETED-PLATE HEAT EXCHANGERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.
2. Delta T Heat Exchangers.
3. ITT Corporation.
4. Mueller, Paul, Company.
5. TACO Incorporated.
6. Wessels
7. Kelvion

B. Configuration: Freestanding assembly consisting of frame support, top and bottom carrying and guide bars, fixed and movable end plates, tie rods, individually removable plates, and one-piece gaskets.

C. Construction: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

D. Frame:

1. Capacity to accommodate [**20**] percent additional plates.
2. Painted carbon steel with provisions for anchoring to support.

E. Top and Bottom Carrying and Guide Bars: Painted carbon steel, aluminum, or stainless steel.

1. Fabricate attachment of heat-exchanger carrying and guide bars with reinforcement strong enough to resist heat-exchanger movement during seismic event when heat-exchanger carrying and guide bars are anchored to building structure.

F. End-Plate Material: Painted carbon steel.

G. Tie Rods and Nuts: Steel or stainless steel.

H. Plate Material: **0.031 inch** hick before stamping; **Type 304L** stainless steel.

I. Gasket Materials: **Nitrile rubber**

1. Glue: Chlorine free.

J. Piping Connections: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

1. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
2. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

K. Enclose plates in solid **stainless-steel** removable shroud.

2.2 ACCESSORIES

A. Hangers and Supports:

1. Custom, steel **supports** for mounting on:
   a. Floor.

2. Ensure both horizontal and vertical support of heat exchanger by providing:
   a. **Factory**-fabricated steel **supports**.

3. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Shroud:
1. **Steel** sheet.

C. Miscellaneous Components for High-Temperature Hot-Water Unit: Control valve, valves, and piping.

D. Miscellaneous Components for Steam Unit: Strainers, steam-control valve, steam trap, valves, pressure gage, thermometer, and piping.

E. Pressure Relief Valves:
1. Cast iron
2. ASME rated and stamped.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect heat exchangers according to ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME label.

B. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.

C. Heat exchangers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and for structural rigidity, strength, anchors, and other conditions affecting performance of heat exchangers.

B. Examine roughing-in for heat-exchanger piping to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GASKETED-PLATE HEAT-EXCHANGER INSTALLATION

A. Install gasketed-plate heat exchanger on custom-designed wall supports anchored to structure as indicated on Drawings.

B. Install metal shroud over installed gasketed-plate heat exchanger according to manufacturer's written instructions.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other;
   1. Section 232113 "Hydronic Piping."
   2. Section 232116 “Hydronic Piping Specialties."
   3. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for steam and condensate piping specified in:
   1. Section 232213 "Steam and Condensate Heating Piping"
   2. Section 232216 “Steam and Condensate Piping Specialties."

C. Maintain manufacturer's recommended clearances for tube removal, service, and maintenance.

D. Install piping adjacent to heat exchangers to allow space for service and maintenance of heat exchangers. Arrange piping for easy removal of heat exchangers.

E. Install shutoff valves at heat-exchanger inlet and outlet connections.

F. Install relief valves on heat-exchanger heated-fluid connection and install pipe relief valves, full size of valve connection, to floor drain.

G. Install vacuum breaker at heat-exchanger steam inlet connection.

H. Install hose end valve to drain shell.

I. Install thermometer on heat-exchanger **and outlet** piping, and install thermometer on heating-fluid **outlet** piping.

J. Comply with requirements for thermometers specified in Section 230519 "Meters and Gages for HVAC Piping."

K. Install pressure gages on heat-exchanger and heating-fluid piping. Comply with requirements for pressure gages specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Heat exchanger will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain heat exchangers.

END OF SECTION 235700

SECTION 236426

ROTARY-SCREW WATER CHILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENT

A. A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Packaged, air-cooled chillers with variable frequency drives (VFD's).

1.3 DEFINITIONS

A. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.

B. BAS: Building automation system.

C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.

D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and referenced to AHRI standard rating conditions.

E. kW/Ton: The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons at any given set of rating conditions.

F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by AHRI 550/590 and intended for operating conditions other than AHRI standard rating conditions.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Centrifugal chillers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified

B. Site Altitude: Chiller shall be suitable for altitude at which installed without affecting performance indicated. Make factory modifications to standard chiller design and adjustments to affected chiller components to account for site altitude, if necessary.

C. Performance Tolerance: Comply with AHRI 550/590.

D. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at ARI standard conditions and at conditions indicated.
2. Performance at ARI standard unloading conditions.
3. Minimum evaporator flow rate.
4. Refrigerant capacity of chiller.
5. Fluid capacity of evaporator.
6. Oil capacity of water chiller.
7. Characteristics of safety relief valves.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, load distribution, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Seismic Qualification Certificates: For chillers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on:

a. Test of assembled components by a nationally recognized testing standard procedure, such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demand determined by Section13.3 of ASCE 7.
b. An engineering analysis conforming to the requirements of Chapter 13 of ASCE 7.
c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Startup service reports.

F. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each chiller to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. AHRI Certification: Certify chiller according to AHRI 550/590 certification program.

B. AHRI Rating: Rate chiller performance according to requirements in AHRI 550/590.

C. AHRI Rating: Chiller sound data measured in accordance with AHRI 370 for units mounted outdoors.

D. ASHRAE Compliance:
1. ASHRAE 15 for safety code for mechanical refrigeration.

2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.

E. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

F. ASME Compliance: Fabricate and label chiller to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and include an ASME U-stamp and nameplate certifying compliance.

G. Comply with NFPA 70, National Electric Code (NEC).

H. Comply with requirements of UL and UL Canada, and include label by a qualified testing agency showing compliance. Units delivered to site without such label shall be field certified by ETL or UL with label registered and field applied. Provide field certification report prepare by the listing agency. All cost for field certification shall be paid by the manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Ship each chiller with a full charge of refrigerant. Charge each chiller with nitrogen if refrigerant is shipped in containers separate from chiller.

B. Ship each oil-lubricated chiller with a full charge of oil.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate anchor bolt sizes, concrete base thickness and anchor bolt edge setback requirements as required by Section 230248 “Vibration Isolation and Seismic Restraint.”

1.11 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Special Warranty: Written warranty, signed by manufacturer agreeing to provide and materials and labor to repair or replace all components including compressor, compressor motor, bearings, related damage, and annual tear down and bearing inspection including replacement of refrigerant for period not less than [Five] years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PACKAGED, WATER-COOLED, SINGLE- AND MULTIPLE-COMPRESSOR CHILLERS

A. MANUFACTURERS – Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a United Technologies company;
2. Daikin Applied (McQuay);
3. Trane, a division of Ingersoll-Rand;
4. York, a Johnson Control Company.

2.2 See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two paragraphs and list of manufacturers below. See Section 016000 "Product Requirements."

2.3 MANUFACTURED UNIT

A. Description: Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, VFD, lubrication system, evaporator, controls, interconnecting unit piping and wiring, and indicated accessories.

B. For chillers with multiple compressors, provide each compressor with a dedicated motor and motor controller , VFD's and provide for continued operation when either compressor-drive assembly fails or is being serviced.

C. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during a seismic event when chiller is anchored to field support structure.

D. Compressor:

1. Description: Hermetic , positive displacement, and oil lubricated.
2. Casing: Cast iron, precision machined for minimum clearance about periphery of rotors.
3. Rotors: Manufacturer's standard two-, or three-rotor design.
4. Seals: Seal drive assembly to prevent refrigerant leakage.

E. Compressor Motor:

1. Continuous-duty, squirrel-cage, induction-type motor with energy efficiency required to suit chiller energy efficiency indicated.
2. Factory mounted, aligned, and balanced as part of compressor assembly before shipping.
3. Motor shall be of sufficient capacity to drive compressor throughout entire operating range without overload and with sufficient capacity to start and accelerate compressor without damage.
4. Provide motor with thermistor or RTD in single motor winding to monitor temperature and report information to chiller control panel.
5. Provide motor with thermistor or RTD to monitor bearing temperature and report information to chiller control panel.

F. Vibration Balance: Balance chiller compressor and drive assembly to provide a precision balance that is free of noticeable vibration over the entire operating range.

1. Overspeed Test: 25 percent above design operating speed.

G. Service: Easily accessible for inspection and service.
1. Compressor's internal components shall be accessible without having to remove compressor-drive assembly from chiller.
2. Provide lifting lugs or eyebolts attached to casing.

H. Capacity Control: Modulating slide-valve assembly or port unloaders combined with hot-gas bypass, if necessary, to achieve performance indicated.

1. Maintain stable operation throughout range of operation. Configure to achieve most energy-efficient operation possible.
2. Operating Range: From 100 to 20 percent of design capacity.

I. Oil Lubrication System: Consisting of pump if required, filtration, heater, cooler, factory-wired power connection, and controls.

1. Provide lubrication to bearings, gears, and other rotating surfaces at all operating, startup, shutdown, and standby conditions including power failure.
2. Thermostatically controlled oil heater properly sized to remove refrigerant from oil.
3. Oil filter shall be the easily replaceable cartridge type, minimum 0.5-micron efficiency, with means of positive isolation while servicing.
4. Refrigerant Refrigerant-cooled oil cooler.
5. Factory-installed and pressure-tested piping with isolation valves and accessories.
6. Oil compatible with refrigerant and chiller components.
7. Positive visual indication of oil level.

J. Refrigerant Circuits:

1. Refrigerant Type: R-134a. Classified as Safety Group A1 according to ASHRAE 34.
2. Refrigerant Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
3. Refrigerant Circuit: Each shall include a thermal- or electronic-expansion valve, refrigerant charging connections, a hot-gas muffler, compressor suction and discharge shutoff valves, a liquid-line shutoff valve, a replaceable-core filter-dryer, a sight glass with moisture indicator, a liquid-line solenoid valve, and an insulated suction line.
4. Pressure Relief Device:

    a. Comply with requirements in ASHRAE 15 and in applicable portions of ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
    b. ASME-rated, spring-loaded pressure relief valve; single- or multiple-reseating type. Pressure relief valve(s) shall be provided for each heat exchanger. Condenser shall have dual valves with one being redundant and configured to allow either valve to be replaced without loss of refrigerant.
5. Refrigerant Isolation: Factory install positive shutoff isolation valves in the compressor discharge line to the condenser and the refrigerant liquid line leaving the condenser to allow for isolation and storage of full refrigerant charge in the chiller condenser shell.

K. Sound Control; Provide with sound reduction kit as follows to meet or exceed the sound criteria specified on the documents:

1. Unit to be furnished with manufacturer's sound reduction kit. Basis of design is York Level 2 Sound Reduction Kit with the following appurtenances:
    a. Acoustic insulation on evaporator, compressor, discharge line and oil separator.
    b. Acoustic insulation-lined sheet metal enclosure around entire bottom half of the unit (including floor plan underneath.)
    c. Ultra-Quite Fans with Variable Speed Control for Optimal Sound Reduction

L. Evaporator:

1. Description: Shell-and-tube design

a. Direct-expansion (DX) type with fluid flowing through the shell, and refrigerant flowing through the tubes within the shell.
b. Flooded type with fluid flowing through tubes and refrigerant flowing around tubes within the shell.

2. Code Compliance: Tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Shell Material: Carbon steel.
4. Shell Heads: Removable carbon-steel heads with multi-pass baffles, and located at each end of the tube bundle.
5. Fluid Nozzles: Terminated with mechanical-coupling or flanged end connections for connection to field piping.
6. Tube Construction: Individually replaceable copper tubes with enhanced fin design, expanded into tube sheets.
7. End Tube Sheets: Continuously welded to each end of shell; drilled and reamed to accommodate tubes with positive seal between fluid in tubes and refrigerant in shell.
8. Intermediate Tube Sheets: Installed in shell and spaced along length of tube at intervals required to eliminate vibration and to avoid contact of tubes resulting in abrasion and wear.

M. Electrical Power:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point, field-power connection to chiller.
2. House in a unit-mounted, NEMA 250, Type 1 enclosure with hinged access door with lock and key.
3. Wiring shall be numbered to match wiring diagram.
4. Install factory wiring outside of an enclosure in a raceway.
5. Field-power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch
   a. Disconnect means shall be interlocked with door operation.
6. b. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.
7. Provide branch power circuit to each motor and to controls with one of the following disconnecting means:
8. Provide each motor with overcurrent protection.
9. Overload relay sized according to UL 1995 or an integral component of chiller control microprocessor.
10. Phase-Failure and Undervoltage Relays: Solid-state sensing with adjustable settings.
11. Control Transformer: Unit-mounted transformer with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
    a. Power unit-mounted controls where indicated.
    b. Power unit-mounted, ground fault interrupt (GFI) duplex receptacle.
12. Control Relays: Auxiliary and adjustable time-delay relays.
13. Motor ControllerRetain first paragraph below for chillers with factory-furnished motor controllers. See Evaluations.
14. Enclosure: Factory installed, unit mounted NEMA 250 Type 3R, with hinged full-front access door.

15. Control Circuit: Obtained from integral control power transformer with a control power transformer of enough capacity to operate connected control devices.
16. Overload Relay: Shall be sized according to UL 1995 or shall be an integral component of chiller control microprocessor.
17. Across-the-Line Controller: NEMA ICS 2, Class A, full voltage, non-reversing; include isolation switch and current-limiting fuses.

18. Accessories: Devices shall be factory installed in controller enclosure unless otherwise indicated.

    a. Externally Operated Disconnect: Fused disconnect switch. Minimum withstand rating shall be as required by electrical power distribution system, but not less than 65,000 A.
    b. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
    c. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
    d. Control Relays: Time-delay relays.
    e. Elapsed-Time Meters: Numerical readout in hours on face of enclosure.
    f. Number-of-Starts Counter: Numerical readout on face of enclosure.
    g. Retain one of first two subparagraphs below if information is not displayed at chiller control panel.

    h. Meters: Panel type, 4-1/4 inches with 120-degree scale and 1 percent accuracy. Where indicated, provide transfer device with an off position. Meters shall indicate the following:

        1) Ammeter: Output current for each phase, with current sensors rated to suit application.
        2) Voltmeter: Output voltage for each phase.
        3) Frequency Meter: Output frequency.
        4) Real-time clock with current time and date.
        5) Total run time.

    i. Phase-Failure, Phase-Reversal, Under-voltage Relays: Solid-state sensing circuit with adjustable under-voltage setting and isolated output contacts for hardwired connection.
    j. Power Protection: Chiller shall shut down within six cycles of power interruption.

N. Variable Frequency Controller:

1. Motor controller shall be factory mounted and wired on the chiller to provide a single-point, field-power termination to the chiller and its auxiliaries.
2. Description: NEMA ICS 2; listed and labeled as a complete unit and arranged to provide variable speed by adjusting output voltage and frequency.
3. Enclosure: Unit mounted, NEMA 250, Type 3R [Type 1] <Insert type>, with hinged full-front access door with lock and key.
4. Integral Disconnecting Means: Door-interlocked, NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.
5. Technology: Pulse width modulated (PWM) output suitable for constant or variable torque loads.

6. Output Rating: Three phase; with voltage proportional to frequency throughout voltage range.

7. Operating Requirements:

    a. Input AC Voltage Tolerance: 460-V ac, plus 10 percent
    b. Input frequency tolerance of 60 Hz, plus or minus 2 Hz.
    c. Capable of driving full load, without derating, under the following conditions:

        1) Ambient Temperature: 0 to 40 deg C.
        2) Relative Humidity: Up to 95 percent (noncondensing).
        3) Altitude: Project Elevation 4300 feet.

    d. Minimum Efficiency: 96 percent at 60 Hz, full load.
    e. Minimum Displacement Primary-Side Power Factor: 98 percent.
    f. Overload Capability: 1.05 times the full-load current for 7 seconds.
    g. Starting Torque: As required by compressor-drive assembly.
    h. Speed Regulation: Plus or minus 1 percent.
    i. Isolated control interface to allow controller to follow control signal over a 10:1 speed range.
    j. To avoid equipment resonant vibrations, provide critical speed lockout circuitry to allow bands of operating frequency at which controller shall not operate continuously.
    k. Capable of being restarted into a motor coasting in either the forward or reverse direction without tripping.

8. Internal Adjustability Capabilities:

    a. Minimum Output Frequency: 6 Hz.
    b. Maximum Output Frequency: 60 Hz.
    c. Acceleration: 2 seconds to 60 seconds.
    d. Deceleration: Zero seconds to 60 seconds.
    e. Current Limit: 30 to a minimum of 100 percent of maximum rating.

9. Self-Protection and Reliability Features: Subjecting the controller to any of the following conditions shall not result in component failure or the need for replacement:

    a. Overtemperature.
    b. Short circuit at controller output.
    c. Ground fault at controller output. Variable frequency controller shall be able to start a grounded motor.
    d. Open circuit at controller output.
    e. Input undervoltage.
    f. Input overvoltage.
    g. Loss of input-phase.
    h. Reverse phase.
    i. AC line switching transients.
    j. Instantaneous overload, line to line or line to ground.
    k. Sustained overload exceeding 100 percent of controller rated current.
    l. Starting a rotating motor.

10. Motor Protection: Controller shall protect motor against overvoltage and undervoltage, phase loss, reverse phase, overcurrent, overtemperature, and ground fault.
11. Automatic Reset and Restart: Capable of three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Controller shall be capable of automatic restart on phase-loss, and overvoltage and undervoltage trips.
12. Visual Indication: On face of controller enclosure or chiller control enclosure; indicating the following conditions:

    a. Power on.
    b. Run.
    c. Overvoltage.
    d. Line fault.
    e. Overcurrent.
    f. External fault.
    g. Motor speed (percent).
    h. Fault or alarm status (code).
    i. Motor output voltage.
    j. Input kilovolt amperes.
    k. Total power factor.
    l. Input kilowatts.
    m. Input kilowatt-hours.
    n. Three-phase input voltage.
    o. Three-phase output voltage.
    p. Three-phase input current.
    q. Three-phase output current.
    r. Output frequency (Hertz).
    s. Elapsed operating time (hours).
    t. Diagnostic and service parameters.

13. Operator Interface: At controller or chiller control panel; with start-stop and auto-manual selector with manual-speed-control potentiometer.
14. Coordinate requirements in subparagraph below with electrical engineer.
15. Harmonic Distortion Filter: Factory mounted and wired to limit total voltage and current distortion to[5 percent.

O. Controls:

1. Standalone and microprocessor based with all memory stored in nonvolatile memory so that reprogramming is not required on loss of electrical power.
2. Enclosure: Unit mounted, NEMA 250, Type 3R hinged or lockable; factory wired with a single-point, field-power connection and a separate control circuit.

3. Operator Interface: Multiple-character digital or graphic display with dynamic update of information and with keypad or touch-sensitive display located on front of control enclosure. In either imperial or metric units, display the following information:

    a. Date and time.
    b. Operating or alarm status.
    c. Fault history with not less than last 10 faults displayed.
    d. Set points of controllable parameters.
    e. Trend data.

f. Operating hours.
g. Number of chiller starts.
h. Outdoor-air temperature or space temperature if required for chilled-water reset.
i. Temperature and pressure of operating set points.
j. Entering- and leaving-fluid temperatures of evaporator
k. Difference in fluid temperatures of evaporator
l. Fluid flow of evaporator
m. Fluid pressure drop of evaporator
n. Refrigerant pressures in evaporator
o. Refrigerant saturation temperature in evaporator
p. Pump status.
q. Antirecycling timer status.
r. Percent of maximum motor amperage.
s. Current-limit set point.
t. Compressor bearing temperature.
u. Motor bearing temperature.
v. Motor winding temperature.
w. Oil temperature.
x. Oil discharge pressure.
y. Phase current.
z. Percent of motor rated load amperes.
aa. Phase voltage.
bb. Demand power (kilowatts).
cc. Energy use (kilowatt-hours).
dd. Power factor.
ee. For chillers equipped with variable frequency controllers and harmonic filters, include the following:

1) Output voltage and frequency.
2) Voltage total harmonic distortion for each phase.
3) Supply current total demand distortion for each phase.
4) Inlet vane position.
5) Controller internal ambient temperature.
6) Heatsink temperature.

4. Control Functions:

a. Manual or automatic startup and shutdown time schedule.
b. Entering and leaving chilled-water temperatures, control set points, and motor load limits. Evaporator fluid temperature shall be reset based on outdoor-air temperature.
c. Current limit and demand limit.
d. External chiller emergency stop.
e. Anti-recycling timer.
f. Variable evaporator flow.
g. Thermal storage.
h. Heat reclaim.

5. Manually Reset Safety Controls: The following conditions shall shut down chiller and require manual reset:

a. Low evaporator pressure or temperature
b. Low evaporator fluid temperature.

c. Low oil differential pressure.
d. High or low oil pressure.
e. High oil temperature.
f. High compressor-discharge temperature.
g. Loss of evaporator-fluid flow.
h. Motor overcurrent.
i. Motor overvoltage.
j. Motor undervoltage.
k. Motor phase reversal.
l. Motor phase failure.
m. Sensor- or detection-circuit fault.
n. Processor communication loss.
o. Motor controller fault.
p. Extended compressor surge.

6. Trending: Capability to trend analog data of up to five parameters simultaneously over an adjustable period and frequency of polling.
7. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: view only; view and operate; and view, operate, and service.
8. Control Authority: At least four conditions: Off, local manual control at chiller, local automatic control at chiller, and automatic control through a remote source.
9. Communication Port: RS-232 port or equivalent connection capable of connecting a printer and a notebook computer.

10. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display chiller status and alarms.

    a. Hardwired Points:

        1) Monitoring: On-off status, common trouble alarm, electrical power demand, electrical power consumption (kilowatt-hours), power factor.
        2) Control: On-off operation, chilled-water, discharge temperature set-point adjustment, electrical power demand limit.

11. ASHRAE 135 BACnet or LonTalk or Modbus (Coordinate with Section 23 0900 “Building Automation System”) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the chiller from an operator workstation. Control features and monitoring points displayed locally at chiller control panel shall be available through the BAS.

P. Insulation:

1. Material: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
2. Thickness: 3/4 inch
3. Adhesive: As recommended by insulation manufacturer and applied to 100 percent of insulation contact surface. Seal seams and joints.
4. Factory-applied insulation over cold surfaces of chiller capable of forming condensation. Components shall include, but not be limited to, evaporator shell and end tube sheets, evaporator water boxes including nozzles, refrigerant suction pipe from evaporator to compressor, cold surfaces of compressor, refrigerant-cooled motor, and auxiliary piping.

a. Apply adhesive to 100 percent of insulation contact surface.
b. Before insulating steel surfaces, prepare surfaces for paint, and prime and paint as indicated for other painted components. Do not insulate unpainted steel surfaces.
c. Seal seams and joints to provide a vapor barrier.
d. After adhesive has fully cured, paint exposed surfaces of insulation to match other painted parts.

Q. Finish:

1. Paint chiller, using manufacturer's standard procedures, except comply with the following minimum requirements:

a. Provide at least one coat of primer with a total dry film thickness of at least 2 mils.
b. Provide at least two coats of alkyd-modified, vinyl enamel [epoxy] [polyurethane] finish with a total dry film thickness of at least 4 mils.
c. Paint surfaces that are to be insulated before applying the insulation.
d. Paint installed insulation to match adjacent uninsulated surfaces.
e. Color of finish coat to be [manufacturer's standard].

2. Provide Owner with quart container of paint used in application of topcoat to use in touchup applications after Project Closeout.

R. Accessories:

1. Flow Switches:

a. If not factory installed, chiller manufacturer shall furnish a switch for each evaporator and verify field-mounting location before installation.
b. Paddle Flow Switches:

1) Vane operated to actuate a double-pole, double-throw switch with one pole field wired to the chiller control panel and the other pole field wired to the DDC system for HVAC.
2) Contacts: Platinum alloy, silver alloy, or gold-plated switch contacts with a rating of 10 A at 120-V ac.
3) Pressure rating equal to pressure rating of heat exchanger.
4) Construct body and wetted parts of Type 316 stainless steel.
5) House switch in a NEMA 250, Type 3R enclosure constructed of die-cast aluminum.
6) Vane length to suit installation.

S. Tool Kit: Chiller manufacturer shall assemble a tool kit specially designed for use in serving the chiller(s) furnished. Include special tools required to service chiller components not readily available to Owner service personnel in performing routine maintenance. Place tools in a lockable case with hinged cover. Provide a list of each tool furnished and attach the list to underside of case cover.

T. Capacities and Characteristics:

1. Capacities and characteristics shall be as scheduled on the Drawings.

2.4 PACKAGED, AIR-COOLED CHILLERS

A. MANUFACTURERS – Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a United Technologies company;
2. Daikin Applied (McQuay);
3. Trane, a division of Ingersoll-Rand;
4. York, a Johnson Control Company.
5. Quantech

2.5 SOURCE QUALITY CONTROL

A. Perform functional tests of chillers before shipping.

B. Factory performance test air-cooled chillers, before shipping, according to AHRI 550/590.

1. Test the following conditions:

   a. Design conditions indicated.
   b. Reduction in capacity from design to minimum load in steps of 10 percent at specified ambient design conditions.
2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

C. Factory sound test chillers, before shipping, according to AHRI 575.

1. Test the following conditions:

   a. Design conditions indicated.
   b. Chiller operating at calculated worst-case sound condition.
   c. At five point(s) of varying part-load performance to be selected by Owner at time of test.
2. Prepare test report indicating test procedures, instrumentation, test conditions, and results. Submit copy of results within one week of test date.

D. For chillers using R-134a refrigerant, factory test and inspect evaporator according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. For chillers located outdoors, rate sound power level according to ARI 370.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine chillers before installation. Reject chillers that are damaged.

B. Examine roughing-in for equipment support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting chiller performance, maintenance, and operations before equipment installation.

1. Final chiller locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CHILLER INSTALLATION

A. Install chillers on support structure indicated.

B. Equipment Mounting:

1. Install chillers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with anchor bolt sizes, concrete base thickness and anchor bolt edge setback requirements as required by Section 230248 “Vibration Isolation and Seismic Restraint.”

C. Maintain manufacturer's recommended clearances for service and maintenance.

D. Charge chiller with refrigerant and fill with oil if not factory installed.

E. Install separate devices furnished by manufacturer and not factory installed.

3.3 CONNECTIONS

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Comply with requirements for piping specified in Section 232113 "Hydronic Piping," Section 232116 Hydronic Piping Specialties," and Section 232300 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 232300 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

D. Install piping adjacent to chiller to allow service and maintenance.

E. Evaporator Fluid Connections: Connect to evaporator inlet with shutoff valve, flexible connector, thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with shutoff valve, balancing valve, flexible connector, flow switch, thermometer, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling flange.

E. Refrigerant Pressure Relief Valve Connections: For water chillers installed indoors, extend vent

piping to the outside without valves or restrictions. Comply with ASHRAE 15.

G. Connect each drain connection with a union and drain pipe and extend pipe, full size of connection, to floor drain. Provide a shutoff valve at each connection if required.

3.4 CLEANING

A. After completing installation, including outlet fittings and devices; inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that refrigerant charge is sufficient and chiller has been leak tested.
3. Verify that pumps are installed and functional.
4. Verify that thermometers and gages are installed.
5. Operate chiller for run-in period.
6. Check bearing lubrication and oil levels.
7. Verify that refrigerant pressure relief device is vented to a safe location.
8. Verify proper motor rotation.
9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator
11. Verify and record performance of chiller protection devices.
12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

C. Prepare written test and inspection report; startup report; findings; and corrective actions. Submit reports to the Architect.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to adjusting, operating, startup and shutdown; troubleshooting; servicing and preventative maintenance of chillers.

1. Review data in the Operation and Maintenance Manual. Refer to Division 1 Section “Contact Closeout”.
2. Schedule training with Owner through the Architect with at least 14 days advance notice.

END OF SECTION 236426

SECTION 236500

COOLING TOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Open-circuit, induced-draft, counterflow cooling towers.

1.3 DEFINITIONS

A. BMS: Building management system.

B. FRP: Fiber-reinforced polyester.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design cooling tower support structure **and seismic restraints**, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Cooling towers shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, furnished specialties, and accessories.

1. Maximum flow rate.
2. Minimum flow rate.
3. Drift loss as percent of design flow rate.
4. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
5. Performance curves for the following:

a. Varying entering-water temperatures from design to minimum.
b. Varying ambient wet-bulb temperatures from design to minimum.
c. Varying water flow rates from design to minimum.
d. Varying fan operation (off, minimum, and design speed).

6. Fan airflow, brake horsepower, and drive losses.
7. Pump flow rate, head, brake horsepower, and efficiency.
8. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
9. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:

1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Sizes and locations of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. **Design Calculations:** Calculate requirements for selecting vibration isolators **and seismic restraints** and for designing vibration isolation bases.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

B. Certificates: For certification required in "Quality Assurance" Article.

C. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Field quality-control reports.

F. Startup service reports.

G. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each cooling tower to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. **Testing Agency Qualifications: Certified by CTI**.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

F. FMG approval and listing in the latest edition of FMG's "Approval Guide."

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. Fan assembly including fan, drive, and motor.
2. All components of cooling tower.
3. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPEN-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS

A. Subject to compliance with requirements, provide one of the following:

1. Baltimore Aircoil Company.
2. Evapco Inc.
3. Marley Cooling Technologies, an SPX Corporation.

B. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

C. Cooling tower designed to resist wind load of **30 lbf/sq. ft.**

D. Casing and Frame:

1. Casing and Frame Material: Galvanized steel, ASTM A 653, G235 coating.

2. **Fasteners: Galvanized** steel.

3. Joints and Seams: Sealed watertight.
4. Welded Connections: Continuous and watertight.

E. Collection Basin:

1. Material:
   a. Stainless steel, 304.

2. **Strainer:** Removable **strainer** with openings smaller than nozzle orifices.

3. Overflow and drain connections.
4. Makeup water connection.
5. Outlet Connection: ASME B16.5, **Class 150** flange.

6. Basin Sweeper Distribution Piping and Nozzles:

   a. Pipe Material: **PVC**.
   b. Nozzle Material: **Plastic**.
   c. Configure piping and nozzles to minimize sediment from collecting in the collection basin.

F. Pressure Reducing Valve: Field installed Direct Type Water Pressure-Reducing Valve. ASME 1003. 150-psig rated working pressure. Bronze body.

G. Electric/Electronic, **Collection Basin Water-Level Controller** with Solenoid Valve:

1. **Enclosure:** NEMA 250, **Type 4**.

2. **Sensor:** Solid-state controls with multiple electrode probes and relays factory wired to a terminal strip to provide **control of water makeup valve, low- and high-level alarms, and output for shutoff of pump on low level .**.

3. Electrode Probes: Stainless steel.

4. Water Stilling Chamber: PVC pipe.

5. **Solenoid Valve:** Controlled and powered through level controller in response to water-level set point:

a. Slow closing **with stainless-steel body**.

6. Electrical Connection Requirements: 120 V, single phase, 60 Hz.

H. Electric **Basin Heater**:

1. Stainless-Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
2. Heater Control Panel: Mounted on the side of each cooling tower cell.
3. **Enclosure:** NEMA 250, **Type 4**.
4. Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low-level set point.
5. Control-circuit transformer with primary and secondary side fuses.
6. Terminal blocks with numbered and color-coded wiring to match wiring diagram.
7. **Single-point**, field-power connection to a **circuit breaker** and heater branch circuiting complying with NFPA 70.
8. Factory Wiring Method: Metal raceway for factory-installed wiring outside of enclosures, except make connections to each electric basin heater with liquidtight conduit.

I. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

1. **Pipe Material:**
   a. PVC.
2. **Spray Nozzle Material:**
   a. PVC.
3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

J. Fill:

1. Materials: Resistant to rot, decay, and biological attack;
   a. **PVC**.
   b. Maximum flame-spread index according to ASTM E 84:
      1) **5**.
2. Minimum Thickness before forming:
   a. **20 mils**.
3. Fabrication: Fill-type sheets, fabricated, formed, and bonded together after forming into removable assemblies that are factory installed by manufacturer.
4. Fill Material Operating Temperature: Suitable for entering-water temperatures up through **120 deg F**.

K. Drift Eliminator:

1. **Material:** Resistant to rot, decay, and biological attack;
   a. FRP or PVC.
2. Maximum flame-spread index of according to ASTM E 84.
   a. **5**.
3. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
4. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.

L. Air-Intake Louvers:

1. **Material: Matching casing**.
2. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out of tower during all modes of operation including operation with fans off.

M. **Removable** Air-Intake Screens:

1. **Galvanized-**steel wire mesh.

N. Axial Fan: Balanced at the factory after assembly.

1. **Blade Material: Aluminum**. Low Sound.
2. **Hub Material: Aluminum.**
3. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens, complying with OSHA regulations.
4. **Fan Shaft Bearings:** Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between **minus 20 and plus 300 deg F**.
   a. Bearings designed for an L-10 life of **50,000** hours.
5. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

O. Belt Drive:

1. Service Factor: **1.5** based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
   a. **Belt:** Multiple V-belt design with a matched set of **cogged** belts.
   b. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
   c. Belt-Drive Guard: Comply with OSHA regulations.

P. Fan Motor:

1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Division 23 "Common Motor Requirements for HVAC Equipment" and not indicated below.
2. **Motor Enclosure: Totally enclosed air over (TEAO)**.
3. **Energy Efficiency: Comply with ASHRAE/IESNA 90.1**.
4. Service Factor: **1.15**.
5. **Insulation: Class F.**
6. Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
7. **Motor Location:** Mounted **outside** of cooling tower casing and cooling tower discharge airstream.
8. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.

Q. Fan Discharge Stack:

1. **Material** shall match casing, **manufacturer's standard** design.
2. Stack Termination: Wire-mesh, galvanized-steel screens; complying with OSHA regulations.

R. Vibration Switch: For each fan drive.

1. **Enclosure:** NEMA 250, **Type 4X**.
2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of **0 to 3000 cycles per minute**. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
3. **Provide switch**; **Field connection to a BMS and** hardwired connection to fan motor electrical circuit.
4. Switch shall, on sensing excessive vibration, **signal an alarm through the BMS and** shut down the fan.

S. Controls: Comply with requirements in Division 23 "Instrumentation and Control for HVAC."

T. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.
2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting tower performance, maintenance, and operation.

1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cooling towers on support structure indicated.

B. Equipment Mounting:

1. Install cooling towers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in:
   a. Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Division 23 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Division 23 "Vibration Controls for HVAC."

C. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to cooling towers to allow service and maintenance.

C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

D. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

E. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

F. Domestic Water Piping: Comply with applicable requirements in Division 22 "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.
1. Install fill line PRV in a heated or freeze proof location. Set pressure to ensure fill to just below the topmost piping point and chiller condenser is always flooded.

G. Supply and Return Piping: Comply with applicable requirements in Division 23 "Hydronic Piping" and Division 23 Hydronic Piping Specialties." Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, **flow meter,** and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a:

1. Union.

H. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.4 FIELD QUALITY CONTROL

A. **Testing Agency: Owner will engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform field tests and inspections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections: Comply with;

1. ASME PTC 23, "ASME Performance Test Codes - Code on Atmospheric Water Cooling Equipment.

E. Cooling towers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. **Engage a factory-authorized service representative to perform** startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Clean entire unit including basins.
b. Verify that accessories are properly installed.
c. Verify clearances for airflow and for cooling tower servicing.
d. Check for vibration isolation and structural support.
e. Lubricate bearings.
f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
g. Adjust belts to proper alignment and tension.
h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
j. Check vibration switch setting. Verify operation.
k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
l. Verify operation of basin heater and control.
m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
n. Replace defective and malfunctioning units.
o. Adjust fill PRV to ensure flooded piping and condenser.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. For systems with galvanized components, perform an anti-corrosion passivation rinse with appropriate acid-solution. Follow correct procedure to rinse acid-solution away as required.

F. Prepare a written startup report that records the results of tests and inspections.

3.6 ADJUSTING

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.7 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

1. Field performance test to include:
    a. Verification of capacity at several load steps
    b. Demonstration of fan control across full range of VFD output, showing the ability of the system to avoid any fan harmonics that are potentially damaging.

END OF SECTION 236500

SECTION 23 7313

CUSTOM AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Custom rooftop air-handling units.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: For the project's largest air handler, submit design calculations, signed by the manufacturer, to certify compliance with the Cabinet and Casing design requirements. See Part 2 of this Specification.

B. Air Leakage Performance: For the project's largest air handler that can be shipped to the job site as a single unit, factory Leak Test results signed by the manufacturer, to certify compliance with the Cabinet and Casing design requirements. See Part 2 of the Specification.

C. Sound Power Levels: Submit sound power level data (discharge opening, inlet opening and radiated through casing) for each air handling unit. The submittal shall include complete description of methods and procedures used to develop the sound power data.

D. Fan/Motor Assembly Balance and Vibration: All fan/motor assemblies shall be factory tested units at design RPM. Maximum vibration shall be within the limits of ANSI/AMCA 205-05 (R2012) Fan Application Category BV-4 Balance Quality Grade 2.5. A certificate of compliance signed by the manufacturer shall be attached to each fan assembly at the factory and incorporated into the Operation and Maintenance Manuals.

E. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified

1.4 ACTION SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.

3. Fans:

    a. AMCA 210 Certified fan-performance curves with system operating conditions indicated.
    b. AMCA 311 Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.
5. Drain Pan ASHRAE 62.1 factory test certification.
6. Dampers, including housings, linkages, and operators.
7. Filters with performance characteristics.
8. Casing design calculations for project's largest air handling unit.
9. Factory Air leakage test results for project' largest air handling unit.
10. Sound power level data for each air handling unit.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
2. Support location, type, and weight.
3. Field measurements.

B. Seismic Qualification Certificates: For air-handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on:

    a. Test of assembled components by a nationally recognized testing standard procedure, such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demand determined by Section13.3 of ASCE 7.
    b. An engineering analysis conforming to the requirements of Chapter 13 of ASCE 7.
    c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish additional materials that match products as installed in the delivered air handlers and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set; for each air-handling unit and to be installed by the Contractor at Substantial Completion.
2. Gaskets: One set for each access door.

1.8 QUALITY ASSURANCE

A. ETL Labeling: List and label units by ETL. If ETL listing and labeling is not available, UL listing and labeling will be acceptable. No other agency listings or labels can be substituted without detailed submittal, review and acceptance in writing. If any is delivered to the site without such label, the manufacturer shall pay all costs to have ETL or UL field certification accomplished and the labels registered and field applied with a field certification report prepared by either agency

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling unit components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. AMCA 210-99, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

G. AMCA 211-05 Certified Ratings Program – Product Rating Manual for Fan Air Performance.

H. AMCA 300-96, Reverberant Room Method for Sound Testing of Fans.

I. AMCA 304-05 Certified Ratings Program – Product Rating Manual for Fan Balance and Vibrations.

J. AMCA 311-05 Certified Ratings Program - Product Rating Manual for Fan Sound Performance.

K. Comply with NFPA 70 National Electric Code (NEC).

L. Manufacturers Qualifications: Provide Air Handling units and major components which are products of Manufacturing Firms regularly engaged in manufacture of equipment with characteristics and capacities as scheduled and whose products have been in satisfactory and similar service for not less than 3-years and must have a minimum of ten (10) working

installations that have been in operation for a least 2-years. Manufacturer must have in-house engineering support.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

C. Coordinate anchor bolts, concrete base thickness and bolt edge setback required by Section 230248 Vibration Isolation and Seismic Restraint.

1.10 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufactures: Subject to compliance with requirements, provide products by one of the following:

1. Air Handlers

    a. Climate Craft.
    b. Energy Labs.
    c. Governair.
    d. Haakon.
    e. Huntair.
    f. Innovent
    g. Temtrol.
    h. Unitech.
    i. York Custom.

2. Fan Array Assemblies

    a. Climate Craft.
    b. Huntair.
    c. Twin City.
    d. Inovent

3. Control Dampers

    a. Ruskin Model CD50.
    b. Greenheck Model VCD-43.
    c. Tamco Series 1000.

2.2 UNIT CASINGS

A. General Fabrication Requirements for Casings:

1. Casings: Double-wall acoustical-thermal panels. Comply with the requirements of the current International Energy Conservation Code (IECC).
2. Casing panels: Self-supporting and capable of withstanding 133 percent of design static pressure as scheduled on the Plans, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within the completed Casing. For the project's largest air handler, submit design calculations, signed by the manufacturer, to certify compliance with the Cabinet and Casing design requirements.
3. Casing leakage: Not to exceed 1 percent of the design flow rate at 133 percent of the design static pressure as scheduled on the Plans. For the project's largest air handler that can be shipped to the job site as a single unit, submit factory Leak Test results signed by the manufacturer, to certify compliance with the Cabinet and Casing design requirements. If no air handlers can be shipped as single units, the largest air handler shall be factory assembled and factory leak tested prior disassembly and shipment. If lead-time or some other circumstance does not allow for factory leak testing then a field leak test shall be conducted at no additional expense to the project. Submit Field Leak Test results signed by the manufacturer to certify compliance with the Cabinet and Casing design requirements.
4. Sealing: Seal all joints with water-resistant sealant.
5. Finish: Manufacturer's standard finish (interior and exterior) is acceptable for indoor air handlers, unless otherwise specified.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Casing Insulation:

1. Materials: ASTM C 1071, Type II.
2. Location and Application: Completely encased between outside and inside casing. A finish bead of caulking will be applied inner liner panel seams to completely encapsulate the insulation.

C. Base Construction:

1. Unit Base: Constructed of structural steel tube or channel shapes framing around the entire perimeter of the unit and provided with intermediate structural tubing or channel shapes as required to support the internal components. All tubing and channel joints shall be solid welded. Base shall be provided with removable lifting lugs minimum (4) per section, located to assure uniform loading.
2. Unit Base Floor: Constructed with minimum 12 gauge steel floor with continuously welded seams and the manufacturer's standard finish. Floor shall be welded to unit base perimeter and intermediate structural tubing or channel shapes.
3. Base Floor Insulation: Minimum 2-inches of sprayed polyurethane foam insulation.
4. Base Floor Openings: Opening in the floor greater than one square foot, including openings with dampers, covered with a removable steel grate, bolted in place. Manufacturer's standard finish for steel floor grates is acceptable. Grates shall be capable of supporting minimum 300 pounds with grate bars spaced to prevent personnel and large objects from fall into duct or space below air handler.
5. Base Finish, Indoor Units: Manufacturers standard finish is acceptable for indoor air handling units.

D. Roof Construction for Outdoor Units:

1. Construction: Weather-Proof, raised standing seams with mechanically formed cleat enclosing standing seam at each roof panel-to-panel joint.
2. Roof Panels Seal: Silicone caulk between panels and with another bead of caulk on panel seams after joining.
3. Roof Slope: Minimum 1 percent.
4. Roof Overlap: minimum of 1-inch over side panels around then entire unit.
5. Doors and Louvers: Provide a formed rain shield extending a minimum of 1-inch from the side walls to direct water away from doors and louvers.
6. [Weather-hoods: provide weather hoods and bird screens over all exposed inlets and outlets. Hoods may be shipped loose and separate for field installation.]
7. [Roof Finish: Exterior finish to have passed ASTM B 117-90 Salt Spray Resistance Test, minimum 1500 hours; ASTM D 2794-90 Impact Test, 160 pounds; ASTM D 2247-87 Humidity Resistance Test, minimum 1500 hour test with maximum blister 1/16-inch.]

E. Interior liners: Minimum 20 gauge steel with manufacturer's standard finish, perforated throughout the unit for the walls and roof, except the cooling coil section and the evaporative cooling section and the plenum section immediately downstream shall have solid interior liner.

F. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced double-wall and insulated panels of same materials, thicknesses and finish as the unit casing.
2. Inspection and Access Panels:

    a. Fasteners: Two or more camlock type for panel lift-out operation.
    b. Arrangement: Shall allow panels to be opened against air-pressure differential.
    c. Gasket: Replaceable, neoprene, bulb-type applied around entire perimeters of panel frames.
    d. Size: Sufficient to allow inspection and maintenance of air-handling unit's internal components.

3. Access Doors:

    a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
    b. Gasket: Replaceable, neoprene, bulb-type applied around entire perimeters of panel frames.
    c. Windows in Doors: Double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior neoprene seals. Minimum window size : 12-inch by 12-inch. Doors with access to moving parts must meet current UL mechanical protection guidelines.
    d. Door Size: Minimum 18 inches wide by full height of unit casing up to a maximum height of 72 inches. In the fan section, the door width must be sufficient for removal and replacement of a fan/motor assembly.

4. Locations and Applications:

    a. Fan Section: Doors with windows.
    b. Access Section: Doors with windows.
    c. Coil Section: Doors with windows.
    d. Damper Section: Doors with windows.
    e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
    f. Mixing Section: Doors with windows.
    g. Humidifier Section: Doors with windows.

G. Lights and Control Wiring

1. Internal Wiring Space: Fabricate air handler to allow minimum 1.5-inch clearance above the entire width of the each interior header-wall (coils, filters, fan septum-wall, etc.). This space is reserved for internal wiring (120-volt or 24-volt) as required by the Controls Contractor.
2. Internal Wiring Conduit: All factory wiring to lights, switches and convenience outlets shall be in conduit and internal to the air handler.
3. Service Lights: Vapor proof, LED A21 Lamp, 14-watt, light fixtures in each accessible section complete with a protective metal cage and sealed enclosure. Wire all lights to a common external junction box with a single illuminate switch, 120-volt GFCI outlet and weatherproof cover.

H. Condensate Drain Pans:

1. Material: Double-wall; 16-gauge, 304-stainless steel sheet, solid welds of all joints, seams and corners with space between walls filled with foam insulation.
2. Slope: Minimum one percent slope (1/8" per foot) in at least two planes
3. Location: Under cooling coils (including coil piping connections, coil headers, and return bends) and outside air inlets.

    a. Length: Extend drain pan H/2 from leaving face in the direction of the air flow, where "H" is the vertical height of the cooling coil, to comply with ASHRAE 62.1 Section 5.
    b. Depth: Minimum of 2-inch deep.
    c. Drain pan shall be fully recessed into the air handler floor.

4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan. Extend through channel/tube base on same side as coil connections unless noted otherwise on Plans.

    a. Minimum Connection Size: MNPS 1-1/4.

5. Drain pan shall conform to all applicable requirements in ASHRAE 62.1.
6. Coils shall be easily removable without cutting or removing any portion of the drain pan.
7. Stacked Coils: Provide an intermediate drain pan to collect condensate from upper coils with drain pipe extending to lower pan.
8. Drain Pan Test: Perform drain pan test in compliance with ASHRAE 62.1 paragraph 7.3 (which permits factory or field testing). Provide manufacturer's written certification of Drain Pan testing.

2.3 MULTIPLE FAN ARRAY UNITS

A. The Multiple Fan Array shall consist of multiple direct-driven Arrangement 4, 12-airfloil blades, non-overloading plenum fans designed and constructed specifically for Multiple Fan Array applications.

B. Fans: Selected to deliver design air flow at the specified operating Total Static Pressure at the specified motor speed as scheduled in the Plans. The Multiple Fan Array shall be selected to operate at a system Total Static Pressure that does not exceed 90 percent of the specified fan's peak static pressure producing capability at the specified fan speed. Fans shall be AMCA 99-208 Class 2 construction.

C. Motors: Inverter-duty, Premium-efficiency T-frame motors selected at the voltage, frequency, and rpm as scheduled on the Plans and complying with requirements in Section 230515 Common Motor Requirements for HVAC Equipment.

D. Dynamic Balance: Comply with AMCA Standard 204-05 (R2012), Fan Application Category BV-4; Balance Quality Grade 2.5. The maximum allowable vibration shall be 0.08 inch per second peak velocity, filter-in as measured at the design fan speed.

1. Vibration Measurements: Taken on each fan bearing in the horizontal, vertical and axial directions. During balancing, the fan shall be imposed with an operating resistance equal to the design external static pressure.
2. Certificate of Compliance: Provide a Certificate of Compliance signed by the manufacturer and incorporated into the Operation and Maintenance Manuals.

E. Motor Shaft Grounding: Factory installed AEGIS Shaft Grounding Ring (SGR) microfiber type. Motor shaft isolation bearings, ceramic bearings and other SGR systems require Prior Approval from the Engineer. All fan motors shall be Lifetime Warranted against bearing failure from EDM pitting.

F. Motor Bearings: Pre-lubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated L-10 life of 200,000 hours according to ABMA 9.

G. Fan/motor assembly Access: Removable through the fan section access door without disassembling the Fan/motor Assembly.

H. Multiple fan installations must have a minimum of two (2) fans. The individual motor size shall not exceed 10.0 horsepower.

I. Blank-off Panel: Provide to temporarily isolate a fan that is not functional. Label the Blank-Off Panel and mount in an accessible location in the Fan Section. Fans with zero pressure drop isolation dampers do not require a Blank-off Panel.

J. Electrical Control Panel:

1. Each Fan/motor Assembly shall be individually wired to an Electrical Control Panel that provides overload protection, short circuit protection and a manual disconnect for each individual fan/motor assembly
2. Code Compliance: Electrical designs, wiring and hardware in accordance with the current NEC, UL 508C and local codes. Electrical Control Panel shall be rated NEMA
3. Label and Listing: Control Panel shall be listed and labeled by UL, CSA or ETL. Air Handling Units not listed and labeled at the factory shall be inspected and labeled by a certified UL/CSA/ETL representative in the field at the manufacturer's expense.
4. Location: Mounted on the exterior of the air handler.
5. Auxiliary Contacts: Provide contacts for alarm connections to the Building Management System.
6. Label and number code all wiring and electrical devices in accordance with the unit electrical diagram.
7. Control and Lighting Power: Provide control and lighting transformers wired to the common main panel terminal block for a single-point electrical connection for the air handling unit.

.2.7 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Hot Water, Chilled Water and Glycol Coils

1. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 - "Construction and Startup."
2. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
3. Working-Pressure/Temperature Ratings: Minimum 250 psig, 325 deg F.
4. Source Quality Control: Factory tested to 400 psig.
5. Tubes: ASTM B 743 copper, minimum 0.625 inch diameter, minimum 0.035 inch thick. Expanded into fin collars to provide permanent mechanical bond
6. Return Bends: Brazed replaceable copper, minimum 0.049 inch thick,
7. Fins: Aluminum, minimum 0.008 inch thick.
8. Headers: Seamless copper tube with brazed joints, prime coated, with cleaning plugs and drain and air vent tappings. Provide braze or copper male thread connections. Connections shall be on the same end of the coil. Extend vent and drain fitting to exterior of casing. All coils shall be fully drainable with no trapped tube.
9. Frames: Galvanized-steel channel frame, minimum 0.064 inch thick for flanged mounting. Provide intermediate coil casing reinforcement so maximum unsupported coil length is 60-inches. Provide integral stacking flanges on the coil for mounting stacked coils.
10. Connections: Supply and return connections shall be raised/lowered to facilitate piping connections near roof, floor and stacked coils. Coils shall be counter-flow design with connections right/left hand as shown on Plans. Use of internal flow restrictive devices, such as turbulator, springs, ribbons, is not acceptable. Extend coil supply and return piping connections through the cabinet wall and sealed with caulking and escutcheons inside and outside of the casing.

2.8 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. UL listed and labeled: UL 900 in accordance with NFPA 90A.
2. Provide minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Filter Section: Fabricated as an integral part of the air handling unit. Filter shall be upstream face loading as indicated on Plans. Face or rear loading shall be in gasketed universal holding frames. The filter rack assemblies shall blanked off to the sides, roof and floor and sealed to minimize filter bypass.
4. Provide filter holding frames arranged for flat or angular orientation, as indicated on Plans, with access doors, as indicated on Plans. Filters shall be lifted out from the access plenum.
5. See Filter Schedule on Plans for filter configuration and maximum filter face velocity.

B. Pleated Panel Filters:

1. Description: Factory-fabricated, self-supported, extended-surface, pleated, panel-type disposable air filters with holding frames.
2. Media: Interlaced glass or synthetic fibers coated with nonflammable adhesive.

    a. Adhesive: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.

b. Media shall be coated with an antimicrobial agent.
c. Separators shall be bonded to the media to maintain pleat configuration.
d. Welded-wire grid shall be on downstream side to maintain pleat.
e. Media shall be bonded to frame to prevent air bypass.

3. Filter-Media Frame: Cardboard frame with perforated metal retainer sealed or boned to the media.
4. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.
5. Capacities and Characteristics:

a. Thickness or Depth: 2-inches.
b. MERV Rating: 8 when tested according to ASHRAE 52.2.

C. Filter Gages:

1. Dwyer 2000 Magnehelic gage; in metal case; white face with black figures; front recalibration adjustment.
2. Accuracy: 2 percent of full-scale.
3. Range: 0- to 2.0-inch w.g.
4. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch plastic tubing, and 3-way vent valves.

2.9 DAMPERS

A. General Requirements for Dampers: Low leak airfoil dampers bearing the AMCA Seal.

B. Air performance and air leakage: Based on tests and procedures performed in accordance with AMCA Publication 511. Comply with the requirements of the AMCA Certified Rating Program. Damper shall be AMCA Leakage Class 1A, 3.0 cubic feet per minute leakage at 1.0 inch w.g. pressure difference; AMCA Leakage Class 1, 8.0 cubic feet per minute leakage at 4.0 inch w.g. pressure difference through a 48-inch by 48-inch damper. Maximum blade length shall be 48-inches.

2.10 Not Used.

2.13 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 400 psig and to 200 psig underwater according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Units that are required to ship in multiple sections shall be assembled per manufacturer's written instructions under the direction of a factory authorized representative.

B. Equipment Mounting:

1. Install air-handling units on cast-in-place concrete equipment bases. Concrete equipment bases shall comply with overall size, thickness, and edge distance for anchor bolts required in Section 230548 "Vibration and Seismic Controls" Submittal.
2. Equipment Bases: Comply with requirements specified in Section 033053 "Miscellaneous Cast-in-Place Concrete".
3. Vibration Isolation and Seismic Control: Comply with requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters are in place. At Substantial Completion, replace temporary filters used during construction and testing, with new clean filters.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance. Piping shall be installed in an accessible cabinet to protect piping.

C. Connect condensate drain pans using NPS 1-1/4, ASTM B 88, Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

D. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties". Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

E. Comply with requirements in Section 233300 "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative, prior to unit startup to inspect, and adjust components, assemblies, and equipment installations including connections.

1. Complete manufacturer’s field assembly, installation and setup checklist.
2. Prepare a written report of findings and recommended corrective actions signed by the factory-authorized service representative. Submit report to Architect along with copies of completed installation and setup checklist.

B. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air-handling Unit or components will be considered defective if Unit or components do not pass tests and inspections.

D. Prepare a written report of findings and corrective actions. Submit written report to Architect.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
8. Comb coil fins for parallel orientation.
9. Verify that proper thermal-overload protection is installed for electric coils.
10. Install new, clean filters.
11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm.

2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.7 CLEANING

A. After completing system installation, inspect interior and exterior finish. Remove burrs, dirt, and construction debris, and repair damaged finishes inkling chips, scratches and abrasions to restore unit to new condition.

B. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings

C. Install new, clean filters prior to Substantial Completion.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.

1. Review data in the Operation and Maintenance Manual. Refer to Division 1 Section “Contract Closeout”.
2. Schedule training with Owner through Architect with at least 7 days advance notice.

END OF SECTION 23 7313

SECTION 237423

PACKAGED, INDIRECT-FIRED, OUTDOOR MAKEUP-AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes indirect-fired makeup-air units.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and configuration of outdoor, indirect-fired makeup-air unit.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type and configuration of outdoor, indirect-fired heating and ventilating unit.

1. Signed, sealed, and prepared by or under the supervision of a qualified professional engineer.
2. Include plans, elevations, sections, and **mounting** details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail fabrication and assembly of gas-fired heating and ventilating units, as well as procedures and diagrams.
5. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
6. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
7. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Startup service reports.

B. Sample Warranty: For manufacturer's special warranty.

C. Certified fan performance curves with system operating conditions indicated.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For indirect-fired makeup-air units to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: **One** set for each unit.

1.8 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Performance: Capacities and air deliveries to be certified by manufacturer as meeting national standards substantiated by valid test information. Airflow capacities to be AMCA rated.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of indirect-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than **five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON Inc.
2. CaptiveAire Systems.
3. Greenheck Fan Corporation.
4. Hastings HVAC; Division of Eric, Inc.
5. Modine Manufacturing Company.
6. Reznor/Thomas & Betts Corporation.
7. Sterling HVAC Products; a Mestek company.
8. Trane Inc.

2.2 SYSTEM DESCRIPTION

A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, and indirect-fired gas burner to be installed exterior to the building.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 UNIT CASINGS

A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets, factory sealed with water-resistant sealant.
3. Factory Finish for **Steel and Galvanized-Steel** Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.
4. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

A. Configuration:

1. Horizontal unit with discharge orientation:
   a. Bottom
2. Support installation: **Roof-mounting.**

B. Cabinet:

1. Panel material;
   a. Aluminized- or galvanized-steel.
2. Panels formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs.
3. Duct flanges at inlet and outlet.
4. Pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

A. Outer Casing:

1. Material;
   a. **0.0598-inch**- thick steel.
2. Finish:
   a. Heat-resistant, baked-enamel
3. Surface prep:
   a. Over-corrosion-resistant-treated surface in color to match fan section.

B. Inner Casing:

1. Burner Section Inner Casing: **0.0299-inch**- thick steel.
2. Internal Insulation: Fibrous-glass duct lining, neoprene coated, comply with ASTM C 1071, Type II, applied on;
   a. Complete unit
   b. Thickness: **1 inch**.
   c. Insulation Adhesive: Comply with ASTM C 916, Type I.

d. Density: **1.5 lb/cu. ft..**

e. Mechanical Fasteners:
   1) Galvanized steel suitable for:
      a) Adhesive attachment to casing.
      b) Mechanical attachment to casing.
      c) Welding attachment to casing.
   2) Application of fastener:
      a) Will not damage liner when applied as recommended by manufacturer.
      b) Will not cause air leakage.

C. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, **Blanket, Type I.**

2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the heating-coil section.

   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive, mechanical, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric, depending on service-air velocity.

3. Location and Application: Encased between outside and inside casing.

D. Condensate Drain Pans:

1. Fabricated with **one** percent slope in at least two planes to collect condensate from condensate-producing heat exchangers and from humidifiers, and to direct water toward drain connection.
   a. Length: Extend drain pan downstream from leaving face.
   b. Depth: A minimum of **2 inches** deep.
2. **Formed sections.**
3. Single-wall, **galvanized**-steel sheet.

2.4 ACCESSORIES

A. Service Platform:

1. Material;
   a. Galvanized Steel.
2. Features:
   a. **42 inches** wide.
   b. Running entire length of unit.
   c. Located on service access side.
   d. Angle side rails.
   e. **4-inch** kick plates.
   f. Expanded metal floor.
3. Ladder;
   a. Fixed ladder.

b. Extending from the top of the side rail to the floor.

B. Duplex, **115-V**, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. **Outlet shall be energized even if the unit main disconnect is open**.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

2.5 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.6 AIR WASHER COOLING SECTION

A. Attributes:

1. 12" Munters CELdek (or equal) evaporative media.
2. Submersible water pump.
3. Schedule 40 P.V.C. water distribution system:
   a. Splash tube spray over media.
   b. Fill valve; Cast brass float type.
   c. Manual bleed valve.
4. Cabinet shall be constructed of:
   a. 18 gage aluminized steel painted exterior.
5. Reservoir shall be:
   a. 20 gage stainless steel.

B. All other items shall comply with Section 237613 “Direct Evaporative Coolers”.

2.7 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Curb Height: 14 inches .
C. Curb Height: 18 inches .

2.8 SUPPLY-AIR FAN

A. Fan Type:
1. Centrifugal, rated according to AMCA 210; statically and dynamically balanced.
2. Fan wheel material; Galvanized steel,
3. Fan wheel mounting; On solid-steel shaft.
4. Bearings, heavy-duty;

a. Self-aligning, permanently lubricated ball bearings.

5. Bearing rating:
   a. L10 of 150,000 hours.

B. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.

C. Fan-Shaft Lubrication Lines: Extended to a location outside the casing.

2.9 AIR FILTERS

A. Comply with [**NFPA 90A**] [**NFPA 90B**].

B. Cleanable Filters: Cleanable metal mesh.

1. Thickness: **1 inch**
2. Maximum Face Velocity: **350 fpm**

2.10 DAMPERS

A. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

2.11 INDIRECT-FIRED GAS BURNER

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47, "Gas-Fired Central Furnaces," and with NFPA 54, "National Fuel Gas Code."

1. CSA Approval: Designed and certified by and bearing label of CSA.
2. Burners: **Aluminized steel with stainless-steel inserts.**
   a. Gas Control Valve:
      1) Modulating.
   b. Fuel: **Natural gas.**
   c. Minimum Combustion Efficiency: **80** percent.
   d. Ignition: Electronically controlled electric spark with flame sensor.
   a. High-Altitude capability, for Project elevation above sea level:
      1) Provided integral to particular Model

B. Venting: Gravity vented.

C. Heat Exchanger: **Aluminized** steel.

D. Heat-Exchanger Drain Pan: Stainless steel.

E. Safety Controls:

1. Vent Flow Verification**: Differential pressure switch to verify open vent**.
2. Control Transformer: **24-V ac**.
3. High Limit: Thermal switch or fuse to stop burner.
4. Gas Train: Regulated, redundant, **24-V ac** gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body with;
   a. Hydraulic-modulating temperature control valve.
5. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.

6. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
7. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.12 UNIT CONTROL PANEL

A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.

B. Control Panel: **Surface-mounted remote panel**, with engraved plastic cover and the following lights and switches:

1. Fan switch: **On-off.**
2. Heat-vent-off switch.
3. Supply-fan operation indicating light.
4. Heating operation indicating light.
5. Thermostat.
6. Damper position potentiometer.
7. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
8. Safety-lockout indicating light.
9. Enclosure: NEMA 250:
   a. Type 1.

2.13 CONTROLS

A. Comply with requirements in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for control equipment and sequence of operation.

B. Fan Control: Interlock fan to start with exhaust fan to which this heating and ventilating unit is associated for makeup air.

C. Temperature Control: Operates gas valve to maintain supply-air temperature.

1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
2. Burner Control: Two or four steps of control using one or two burner sections in series.

D. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display status and alarms of heating and ventilating unit.

1. Hardwired Points:

   a. Room temperature.
   b. Discharge-air temperature.
   c. Burner operating.

2.14 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Enclosure:
   a. Open, dripproof.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Verify cleanliness of airflow path to include inner-casing surfaces, filters, coils, turning vanes, fan wheels, and other components.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install heating and ventilating unit on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.

B. Unit Support:

1. Install heating and ventilating unit level on structural; **curbs**.
2. Coordinate wall penetrations and flashing with wall construction.

C. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."

D. Install controls and equipment shipped by manufacturer for field installation with indirect-fired heating and ventilating units.

A. Roof Curb (provided by unit mfg):

1. Install on roof structure or concrete base, level and secure, according to;
   a. NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts."
2. Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories."
3. Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

A. Unit Support (field fabricated):

1. Install unit level on structural **curbs**.
2. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Gas Piping:
   a. Comply with requirements in:
   b. Section 231123 "Facility Natural-Gas Piping."
   c. Connect gas piping with shutoff valve and union, and with sufficient clearance for burner removal and service.
   d. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.

B. Drain:
1. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to condensate drain pans under condensing heat exchangers.
2. Where installing piping adjacent to heating and ventilating units, allow space for service and maintenance.

C. Duct Connections:

1. Connect supply ducts to direct-fired heating and ventilating units with flexible duct connectors.

2. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

A. Perform tests and inspections **with the assistance of a factory-authorized service representative**.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. **Engage a factory-authorized service representative to perform** startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to burner combustion chamber.
2. Inspect casing insulation for integrity, moisture content, and adhesion.

3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Purge gas line.
6. Inspect and adjust vibration isolators.
7. Verify bearing lubrication.
8. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
9. Adjust fan belts to proper alignment and tension.

C. Start unit according to manufacturer's written instructions.

1. Complete startup sheets and attach copy with Contractor's startup report.
2. Inspect and record performance of interlocks and protective devices; verify sequences.
3. Operate unit for run-in period recommended by manufacturer.
4. Perform the following operations for both minimum and maximum firing, and adjust burner for peak efficiency:

    a. Measure gas pressure at manifold.
    b. Measure combustion-air temperature at inlet to combustion chamber.
    c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

5. Calibrate thermostats.
6. Adjust and inspect high-temperature limits.
7. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
8. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
9. Measure and record airflow. Plot fan volumes on fan curve.
10. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:

    a. High-limit heat.
    b. Alarms.

11. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
12. Verify drain-pan performance.
13. Verify outdoor-air damper operation.

3.6 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within **12** months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain heating and ventilating units.

END OF SECTION 237423

SECTION 238126

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Detailed description of equipment anchorage devices their installation requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For evaporator-fans, compressor-condensers, accessories, and components, provide from manufacturer:

1. Basis for Certification: Indicate whether “withstand” certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Two sets for each unit. One filter to be installed for use during startup and Testing & Balancing. The contractor shall install the second filter at the time of Substantial Completion.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. [National Roofing Contractors Association (NRCA) Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.]

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor, parts and labor: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Provide one of the following:

1. Carrier Corporation; a unit of United Technologies Corp.;
2. Lennox Industries, Inc.; Lennox International;
3. Mitsubishi Electric & Electronics USA, Inc.;
4. Sanyo North America Corporation
5. Trane Company a division of Ingersoll-Rand;
6. York; a Johnson Controls company

2.2 INDOOR UNITS

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in, manufacturers standard color and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    d. Mount unit-mounted disconnect switches on interior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans: Comply in all respects with ASHRAE 62.1. Provide condensate pump with minimum 9 inch [24 inch] lift and safety shutoff switch.
7. Air Filtration Section: Permanent, cleanable.

2.3 OUTDOOR UNITS

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, manufacturers standard finish and color with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-410A
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid sub-cooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Provide additional components to permit operation down to 10 deg F.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

2.5 CAPACITIES AND CHARACTERISTICS

A. Capacities and characteristics shall be as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Evaporator-fan Components Mounting: Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Compressor-condenser Components Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Concrete equipment bases shall comply with overall size, thickness,

and edge distance for anchor bolts required in Section 230548 “Vibration and Seismic Controls” Submittal. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Install roof-mounted, compressor-condenser components on roof curb provided by manufacturer in compliance with NRCA requirements. Secure equipment to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts required in Section 230548 “Vibration and Seismic Controls” Submittal.
4. Coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories."

D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Equipment”.

D. Electrical Connections: Comply with requirements in Division 26 Section for power wiring, switches, and motor controls

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test & inspection reports and corrective actions. Submit written reports to the Architect.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel on procedures and schedules related to adjusting, operating, startup and shutdown; troubleshooting; servicing and preventative maintenance of Units.

1. Review data in the Operation and Maintenance Manual. Refer to Division 1 Section “Contact Closeout”.
2. Schedule training with Owner through the Architect with at least 14 days advance notice.

END OF SECTION 238126

SECTION 238219

FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ductless fan coil units and accessories.
2. Ducted fan coil units and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of fan coil unit indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which fan coil units will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

6. Perimeter moldings.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 "Operation and Maintenance Data," include the following:

a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Coil Unit Filters: Furnish **two** spare filters for each filter installed.
2. Fan Belts: Furnish **two** spare fan belts for each unit installed.

1.7 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.
b. Condenser coil leak.

2. **Warranty Period**: **Four** years from date of Substantial Completion.

3. **Warranty Period (Compressor Only): Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTLESS FAN COIL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Airtherm; a Mestek Company.
2. Carrier Corporation; a UTC company.
3. ENVIRO-TEC; by Johnson Controls, Inc.
4. First Company Products.
5. Greenheck Fan Corporation.
6. McQuay International; Daikin Industries.
7. Nailor Industries Inc.
8. Titus.
9. Trane Inc.
10. YORK; by Johnson Controls, Inc.

B. Fan Coil Unit Configurations: Row split.

1. **Number of Heating Coils: One** with **two**-pipe system.
2. **Number of Cooling Coils: One** with **two**-pipe system.

C. **Coil Section Insulation**: **1/2-inch**- thick, **coated glass fiber** complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of **25** and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.

D. Coil Section Insulation: Insulate coil section according to Division 23 "HVAC Equipment Insulation."

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of **25** and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.

E. **Main and Auxiliary Drain Pans**: **Insulated galvanized steel with plastic liner**. Fabricate pans and drain connections to comply with ASHRAE 62.1. **Drain pans shall be removable.**

F. **Chassis**: Galvanized steel where exposed to moisture, **with baked-enamel finish and removable access panel**. Floor-mounting units shall have leveling screws.

G. **Cabinet**: Steel with **baked-enamel finish in manufacturer's standard paint color as selected by Architect**.

1. **Vertical Unit Front Panels**: Removable, steel, with **steel** discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.

2. **Horizontal Unit Bottom Panels**: Fastened to unit with cam fasteners and hinge and attached with safety chain; with **cast-aluminum** discharge grilles.

H. **Filters**: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.
1. Washable Foam: **70 percent** arrestance and MERV **3**.

I. **Hydronic Coils**: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**, rated for a minimum working pressure of **200 psig** and a maximum entering-water temperature of **220 deg F**. Include manual air vent and drain valve.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

J. Control devices and operational sequences are specified in Division 23 "Instrumentation and Control for HVAC" and Division 23 "Sequence of Operations for HVAC Controls."

K. **DDC** Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied-Period-Override Operation: **Two** hours.
3. Unit Supply-Air Fan Operation:

a. Occupied Periods: Fan runs continuously.
b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Hydronic Cooling-Coil Operation:

a. **Occupied Periods**: **Modulate** control valve to provide cooling if room temperature exceeds thermostat set point.

b. Unoccupied Periods: Close control valve.

5. Heating-Coil Operation:

a. **Occupied Periods**: **Open control valve** to provide heating if room temperature falls below thermostat set point.

b. **Unoccupied Periods**: Start fan and **open control valve** if room temperature falls below setback temperature.

6. Controller shall have volatile-memory backup.

L. Building Automation System (BAS) Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide **BACnet** interface for central BAS workstation for the following functions:

a. Adjust set points.
b. Fan coil unit start, stop, and operating status.
c. Data inquiry to including supply-and room-air temperature.
d. Occupied and unoccupied schedules.

M. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.3 DUCTED FAN COIL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; a UTC company.
2. ENVIRO-TEC; by Johnson Controls, Inc.
3. First Company Products.
4. Greenheck Fan Corporation.
5. McQuay International; Daikin Industries.
6. Nailor Industries Inc.
7. Titus.
8. Trane Inc.
9. YORK; by Johnson Controls, Inc.

A. Fan Coil Unit Configurations: Row split.

1. **Number of Heating Coils: One** with **two**-pipe system.
2. **Number of Cooling Coils: One** with **two**-pipe system.

A. **Coil Section Insulation**: **1/2-inch**- thick, **coated glass fiber** complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of **25** and smoke-developed index of **50** when tested according to ASTM E 84 by a qualified testing agency.

B. Coil Section Insulation: Insulate coil section according to Section 230616 "HVAC Equipment Insulation."

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of **25** and smoke-developed index of **50** when tested according to ASTM E 84 by a qualified testing agency.

A. **Main and Auxiliary Drain Pans**: **Insulated galvanized steel with plastic liner**. Fabricate pans and drain connections to comply with ASHRAE 62.1. **Drain pans shall be removable.**

B. **Chassis**: Galvanized steel where exposed to moisture, **with baked-enamel finish and removable access panel**. Floor-mounting units shall have leveling screws.

C. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

1. **Supply-Air Plenum**: Sheet metal plenum finished and insulated to match the chassis.
2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with return-air, formed-steel dampers.
4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

D. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

1. Washable Foam: **70 percent** arrestance and MERV **3**.

E. **Hydronic Coils**: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**, rated for a minimum working pressure of **200 psig** and a maximum entering-water temperature of **220 deg F**. Include manual air vent and drain.

F. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

G. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

H. Control devices and operational sequence are specified in Division 23 "Vibration and Seismic Controls for HVAC Piping and Equipment."

I. **DDC** Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied-Period-Override Operation: **Two** hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Hydronic-Cooling-Coil Operation:

a. **Occupied Periods**: **Modulate** control valve to provide cooling if room temperature exceeds thermostat set point.

b. Unoccupied Periods: Close control valve.

5. Heating-Coil Operation:

a. **Occupied Periods**: **Open control valve** to provide heating if room temperature falls below thermostat set point.

b. **Unoccupied Periods**: Start fan and **open control valve** if room temperature falls below setback temperature.

6. Controller shall have volatile-memory backup.

J. Building Automation System (BAS) Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.
3. Provide **BACnet** interface for central BAS workstation for the following functions:

a. Adjust set points.
b. Fan coil unit start, stop, and operating status.
c. Occupied and unoccupied schedules.

K. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, to receive fan coil units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan coil unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fan coil units level and plumb.

B. Install fan coil units to comply with NFPA 90A.

C. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices:
1. **48 inches** above finished floor.

E. Install new filters in each fan coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

B. Connect supply-air and return-air ducts to fan coil units with flexible duct connectors specified in Division 23 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Division 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. **Testing Agency: Owner will engage** a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative:**

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within **12 months** of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 238219

SECTION 238239

CABINET UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cabinet unit heaters with centrifugal fans and **hot-water** coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of piping valves and specialties.
7. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit-Heater Filters: Furnish **one** spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Airtherm.
2. Dunham-Bush.
3. McQuay International; Daikin Industries.
4. Modine Mfg. Co.
5. Rittling
6. Ted Reed Thermal, Inc.
7. Trane.
8. Young Radiator Co.

2.2 DESCRIPTION

A. Factory-assembled and -tested unit complying with AHRI 440.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 COIL SECTION INSULATION

A. **Insulation Materials**: ASTM C 1071; surfaces exposed to airstream shall have **aluminum-foil facing** to prevent erosion of glass fibers.

1. Thickness:
   a. 1/2 inch .
2. Thermal Conductivity (k-Value): **0.26 Btu x in./h x sq. ft. at 75 deg F** mean temperature.
3. Fire-Hazard Classification: Maximum **flame-spread index of 25 and smoke-developed index of 50** when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

2.4 CABINETS

A. **Material**: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect

1. Vertical Unit, Exposed Front Panels: Removable panels with channel-formed edges secured with tamperproof cam fasteners.
   a. Minimum thickness: **15GA-0.0673-inch-** sheet steel.
2. Control Access Door: Key operated.
3. Base: Minimum **0.0528**-inch- thick steel, finished to match cabinet:
   a. **6 inches** high with leveling bolts.
4. Extended Piping Compartment: **8-inch-** wide piping end pocket.
5. False Back: Minimum **0.0428**-inch- thick steel, finished to match cabinet.
6. **Outdoor-Air Wall Box**: Minimum **0.1265**-inch- thick, aluminum, rain-resistant louver and box with integral eliminators and bird screen; aluminum louver with **baked-enamel** finish in color selected by Architect from manufacturer's **standard** colors.

2.5 FILTERS

A. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Washable Foam: **70 percent** arrestance and **MERV 3**.

2.6 COILS

A. **Hot-Water Coil**: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch** and rated for a minimum working pressure of **200 psig** and a maximum entering-water temperature of **220 deg F**. Include manual air vent and drain.

2.7 CONTROLS

A. Fan and Motor Board: Removable.

1. **Fan**: Forward curved, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.

B. **Factory, Hot-Water Piping Package**: **ASTM B 88, Type L** copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Provide equipment for one of the following operated valve arrangements:

a. **Calibrated-Orifice Balancing Valves**: Bronze body, ball type, **125-psig** working pressure, **250 deg F** maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

2. Control valve:
   a. **Two-way, modulating** control valve.

3. **Hose Kits**: Minimum **400-psig** working pressure, and operating temperatures from **33 to 211 deg F**. Tag hose kits to equipment designations.

   a. Length: 24 inches.
   b. Minimum Diameter: Equal to cabinet unit-heater connection size.

4. **Two-Piece, Ball Valves**: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and **600-psig** minimum CWP rating and blowout-proof stem.
5. **Y-Pattern, Hot-Water Strainers**: Cast-iron body (ASTM A 126, Class B); **125-psig** minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 threaded pipe and full-port ball valve in strainer drain connection.
6. **Wrought-Copper Unions**: ASME B16.22.

C. Control devices and operational sequences are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls."

D. DDC Terminal Controller:

E. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at central workstation.
3. **Interface** shall be **BAC-net** compatible for central BAS workstation and include the following functions:

   a. Adjust set points.
   b. Cabinet unit-heater start, stop, and operating status.
   c. **Data inquiry**, including supply-air and room-air temperature.
   d. Occupied and unoccupied schedules.

F. Electrical Connection: Factory-wired motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548.13 "Vibration Controls for HVAC."

D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 "Hydronic Piping," Division 23 Hydronic Piping Specialties," Division 23 "Steam and Condensate Heating Piping," and Division 23 Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 "Air Duct Accessories."

E. Comply with safety requirements in UL 1995.

F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Division 23 "Hydronic Piping" and Division 23 Hydronic Piping Specialties."

G. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of cabinet

unit heater. Steam specialties are specified in Division 23 Steam and Condensate Piping Specialties."

H. Ground equipment according to Division 23 "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Division 23 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **two** visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. **Train** Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 238239

SECTION 26 0500

ELECTRICAL GENERAL PROVISIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full.

1.2 SCHEDULE OF ALTERNATES:

A. Alternate No. 1 – Alternative Lighting Control System

1. Per Section 26 0943 - Lighting Control Equipment, the base lighting control system shall be a Wattstopper system. As an alternate, a Lutron Vive and/or Athena lighting control system may be submitted under Alternate No. 1, accounting for any adjustments to the system and labor costs. Any proposed alternative shall include necessary drawing adjustments and provide a complete, fully operational system that meets or exceeds the performance of the specified basis of design

1.3 DESCRIPTION OF WORK:

A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items.

	ITEM	SECTION
1.	Electrical General Provisions	26 0500
2.	Mechanical and Electrical Coordination	26 0501
3.	Electrical Submittals O & M Manuals and Spare Parts	26 0502
4.	Electrical Connections for Equipment	26 0507
5.	Elevator Electrical Requirements	26 0510
6.	Conductors and Cables	26 0519
7.	Grounding	26 0526
8.	Supporting Devices	26 0529
9.	Conduit Raceway	26 0532
10.	Electrical Boxes and Fittings	26 0533
11.	Raceway Systems	26 0536
12.	Electrical Seismic Control	26 0548
13.	Electrical Identification	26 0553
14.	Protective Device Study	26 0573
15.	Occupancy Sensors	26 0923
16.	Lighting Control Equipment	26 0943
17.	Energy & Power Metering System	26 1010
18.	Transformers	26 2200
19.	Switchgear and Switchboards	26 2413

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20.	Panelboards	26 2416
21.	Service Entrance	26 2713
22.	Wiring Devices	26 2726
23.	Overcurrent Protective Devices	26 2815
24.	Motor and Circuit Disconnects	26 2816
25.	Motor Starters	26 2913
26.	Variable Frequency Drives	26 2923
27.	Emergency Power Inverter System	26 3214
28.	Surge Protective Devices (SPD)	26 4313
29.	Interior and Exterior Building Lighting	26 5100
30.	Exterior Area Lighting	26 5600
31.	System Commissioning	26 9000
32.	Telephone/Data Systems	27 1500
33.	Audiovisual Systems	27 4100
34.	Audiovisual System Checklists	27 4101
35.	Intercommunication Systems	27 5123
36.	Public Safety DAS/ERRCS	27 5320
37.	Common Requirements for Access Control, & Video Surveillance Systems	28 0501
38.	Access Control System	28 2205
39.	IP Video Surveillance System	28 2300
40.	Intelligent Fire Alarm & Detection System	28 3111
41.	Appendix A – CCSD Hyde Park ES Public Safety DAS/ERRCS System Preliminary Design	

B. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and systems required as a portion of this work.

C. Visit the site during the bidding period to determine existing conditions affecting electrical and other work. All costs arising from site conditions and/or preparation shall be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.4 DEFINITION OF TERMS:

A. The following terms used in Divisions 26, 27 and 28 documents are defined as follows:

1. "Provide": Means furnish, install and connect, unless otherwise indicated.
2. "Furnish": Means purchase and deliver to project site.
3. "Install": Means to physically install the items in-place.
4. "Connect": Means make final electrical connections for a complete operating piece of equipment.

1.5 RELATED SECTIONS:

A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

B. General and Supplementary Conditions: Drawings and general provisions of contract and Division 1 of the Specifications, apply to all Division 26, 27 and 28 sections.

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C. Earthwork:

1. Provide trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, buried cable, in-grade pull boxes, manholes, lighting pole foundations, etc. See Division 31, Sitework, and other portions of Divisions 26, 27 and 28, for material and installation requirements.

D. Concrete Work:

1. Provide forming, steel bar reinforcing, cast-in-place concrete, finishing and grouting as required for underground conduit encasement, light pole foundations, pull box slabs, vaults, equipment pads, etc. See Division 3, Concrete for material and installation requirements.

E. Miscellaneous Metal Work:

1. Provide fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor controls centers, etc. See Division 5, Metals for material and installation requirements.

F. Miscellaneous Lumber and Framing Work:

1. Provide wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. See Division 6, Rough Carpentry for material and installation requirements.

G. Moisture Protection:

1. Provide membrane clamps, sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors and ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight. See Division 7, Thermal and Moisture Protection for material and installation requirements.

H. Access panels and doors:

1. Provide in walls, ceiling, and floors for access to electrical devices and equipment. See Division 8, Doors and Windows for material and installation requirements.

I. Painting:

1. Provide surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, poles, surface metal raceways, etc. See Division 9, Finishes for material and installation requirements.

1.6 WORK FURNISHED AND INSTALLED UNDER ANOTHER SECTION REQUIRING CONNECTIONS UNDER THIS SECTION:

A. Provide electrical service, make requisite connections and perform operational test. Items furnished and installed under other sections and connected under this section, include but are not limited to the following:

1. Electric motors.
2. Package mechanical equipment: fans, fan coil units, pumps, boilers, duplex compressors, etc.
3. Flow switches and valve monitors.
4. Motorized dampers.
5. Fire and smoke dampers
6. Duct mounted smoke detectors.
7. Elevator/Escalator Controllers.

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8. Irrigation controllers.
9. Door hold-open/release devices.
10. Motorized projection screens.
11. Wheel chair lifts.
12. Roll down doors.
13. Electric hardware.
14. Temperature control panels.
15. Variable frequency controllers.
16. Chiller starters.
17. Motorized Chalkboards/Markerboards/Whiteboards.
18. Display cases.
19. Water coolers.
20. Kitchen equipment including ovens, fryers, mixers, disposers, dishwashers, etc.
21. Fire sprinkler alarm bells.
22. Electric heat trace cable for domestic and industrial hot water piping systems.
23. Electric heat trace cable for guttering, drain lines, etc.
24. Anti-sweat heaters, fan coils, etc. for walk-in coolers and freezers.
25. Hand dryers, hair dryers.
26. Systems/Open Office Furniture

1.7 ITEMS FURNISHED UNDER ANOTHER DIVISION, BUT INSTALLED AND CONNECTED UNDER THIS DIVISION:

A. Items furnished under other Divisions, but turned over to Division 26 for installation and final connection include, but are not necessarily limited to, the following:

1. Wall mounted control stations for motorized roll-up doors/grills.
2. Wall mounted control stations for motorized projection screens.
3. Wall mounted control stations for handicap lift.
4. Lighting fixtures for kitchen hoods.
5. Lighting fixtures for walk-in freezers and coolers.

1.8 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:

A. Before bidding, Contractor shall familiarize himself with the drawings, specifications and project site. Submit requests for clarification to Architect/Engineer in writing prior to issuance of final addendum. After signing the contract, the Contractor shall meet the intent, purpose, and function of the Contract Documents. Any costs of materials, labor and equipment arising therefrom, to make each system complete and operable, is the responsibility of the Contractor.

1.9 REQUESTS FOR INFORMATION (RFIs):

A. Contractor shall review all Contract Documents thoroughly before submitting an RFI to avoid unnecessary questions and ensure the question has not already been addressed within the existing Contract Documents.

B. RFIs should be used to seek clarification on issues or areas of confusion that cannot be resolved through a review of the Contract Documents.

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C. Each RFI shall contain the following:

1. Description of the Issue/Question: Clearly detail the issue or confusion, referencing the related Contract Document drawings and/or specifications.
2. Relevant Documents: Attach any necessary supporting documents that could aid in understanding the RFI.
3. Proposed Solution: Suggest a possible resolution to the problem or confusion.

D. Non-Compliant RFIs

1. Frivolous or incomplete RFIs will not be accepted. RFIs that do not follow the guidelines set forth in this section, or are deemed unnecessary, may be returned without response at the discretion of the Engineer.

1.10 QUALITY ASSURANCE:

A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies refers to the latest edition of such publications adopted and published prior to submittal of the bid proposed, unless noted otherwise herein. Such codes or standards are considered a part of this specification as though fully repeated herein.

B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred as reducing the quality, requirements or extent of the Drawings and Specifications. Perform work in accordance with applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:

1. National Electric Code (NEC).
2. International Building Code (IBC).
3. International Fire Code (IFC).
4. International Mechanical Code (IMC).

C. Standards: Comply with the following standards where applicable for equipment and materials specified under this Division.

1.	UL	Underwriters' Laboratories
2.	ASTM	American Society for Testing Materials
3.	CBN	Certified Ballast Manufacturers
4.	IPCEA	Insulated Power Cable Engineers Association
5.	NEMA	National Electrical Manufacturer's Association
6.	ANSI	American National Standards Institute
7.	ETL	Electrical Testing Laboratories

D. All electrical apparatus furnished under this Section shall conform to (NEMA) standards and the NEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.

E. Comply with requirements of State and Local Ordinances. If a conflict occurs between these requirements and the Contract Documents, the most stringent requirements shall govern. The Contractor accepts this responsibility upon submitting his bid, and no extra charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the Contract Documents that may be in excess of the aforementioned requirements, and not contrary to same.

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F. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.

G. Employ only qualified craftsmen with at least three years of experience. Workmanship shall be neat, have a good mechanical appearance and conform to best electrical construction practices. Provide a competent superintendent to direct the work at all times. Any person found incompetent shall be discharged from the project and replaced by satisfactory personnel.

H. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.

I. Required Pre-Electrical Construction Meeting with Electrical Engineer: Electrical contractor/representative will be required to attend a pre-electrical construction meeting (approximately 30-60 minutes) with engineering representative in the electrical engineer's office prior to electrical construction commencement. This meeting will address any questions on the part of the contractor and the expectations of the Engineer with regard to specifications, plans and site visits for both rough and finish electrical work.

1.11 CONSTRUCTION CHANGE ORDER PROPOSALS

A. In the event that a submission of a change order is issued by the contractor, the following information will be required to be submitted by the contractor, prior to any consideration by the owner/architect.

a. All equipment, including conduit and wire, shall be itemized, identifying unit costs and quantities of equipment. Distributor quotes shall accompany all change order requests. The distributor quotes shall include costs for all equipment including conduit and wire. Lot pricing for equipment is not acceptable.

b. The general contractor shall review and confirm that the quantity and costs of materials submitted appear reasonable for the scope proposed.

c. Labor units shall not exceed base NECA #1 standards. No adjustment factors shall be approved.

d. Any research and labeling time, shall be the responsibility of the electrical contractor and shall not be included in the change order request.

e. Any costs associated with the purchase of tools or transportation shall be fully itemized for review by architect/owner.

f. Overtime rates shall only be approved where additional manpower cannot achieve the same result.

g. Change order form shall follow the following format:

i. PCO number

ii. Detailed description of work being performed

iii. Location on project where work is performed

iv. Chosen NECA column

v. Identified material:

1. QTY
2. Unit cost
3. Mark up
4. Material total

vi. Identified labor:

1. QTY
2. Unit cost
3. Composite labor rate
4. Labor total

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1.12 RECORD DRAWINGS:

A. Maintain, on a daily basis, a complete set of “Record Drawings”, reflecting an accurate record of work in accordance with the following:

1. Show the complete routing and location of all feeders rated 100 amps and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.)
2. Show the complete routing and location of all telecommunications conduits, systems raceways, and empty raceways, 1-1/4" and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.).
3. Show all changes, deviations, addendum items, change orders, job instructions, etc., that change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.

B. At the discretion of the Architect/Engineer, the drawings will be reviewed on a periodic basis and used as a pre-requisite for progress payments. This requirement shall not be construed as authorization for the Contractor to make changes in the layout, or work without written authorization for such changes. The “Record Drawings” for daily recording shall consist of a set of blue line prints of the Contract Drawings.

C. Upon completion of the work, purchase a complete set of electronic drawings. Transfer all “Record” information from the blue line prints to the drawings via the current CAD program that it was written. The Architect/Engineer shall review the drawings and the Contractor shall incorporate the resulting comments into the final record drawings. The Contractor shall make two complete copies of the drawings electronically and forward this to the Engineer.

D. Certify the “Record Drawings” for correctness by placing and signing the following certifications of the first sheet of the drawings:

"CERTIFIED CORRECT (3/8" high letters)

(Name of General Contractor)

By: _____ Date: _____

(Name of Electrical Contractor)

By: _____ Date: _____

1.13 GUARANTEE:

A. Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes. Without additional charge, replace any work or materials that develop defect, except from ordinary wear and tear, within one year from the date of substantial completion. Exception: Incandescent and fluorescent lamps shall be guaranteed for a period of two months from the date of substantial completion.

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1.14 OTHER:

A. Right to Hire. “Client” agrees that during the project and for a period of twenty four (24) months following substantial completion that it will not, directly or indirectly, employ or solicit to employ BNA Personnel.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Products are specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

2.2 MANUFACTURERS:

A. Provide products of manufacturers specified. Manufacturers catalog numbers and descriptions establish the quality of product required. Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Architect/Engineer eight (8) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.

B. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.

C. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

D. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.

E. Provide only equipment specified in the Contract Documents or approved by addendum.

2.3 SPARE PARTS:

A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done

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only with the consent of that Contractor. Cutting structural members shall not be permitted.

B. Since the drawings of floor, wall, and ceiling installation are made at small scale; outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings, but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.

C. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc., or from being located in chalkboards, tackboards, glass panels, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.

D. Coordinate the location of outlets, devices, connections, and equipment with the supplier of the systems furniture prior to rough-in.

E. Where conduit, outlets or apparatus are to be encased in concrete, it must be located and secured by a journeyman or foreman present at the point of installation. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.

F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

3.2 CLEAN:

A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.

B. Clean fixtures, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

3.3 POWER OUTAGES:

A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the Owner. Include all costs for overtime work in bid.

B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.

C. Keep all outages to an absolute minimum.

3.4 STORAGE AND PROTECTION OF MATERIALS:

A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.5 EXCAVATING FOR ELECTRICAL WORK:

A. General: Locate and protect existing utilities and other underground work in manner that will ensure that no damage or service interruption will result from excavating and backfilling. Perform excavation in a manner that protects walls,

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footings, and other structural members from being disturbed or damaged in any way. Burial depths must comply with NEC Section 300-5 (or State of Utah requirement, whichever is more stringent), unless noted otherwise on drawings.

B. Protect persons from injury at excavations, by barricades, warnings and illumination.

C. Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.

D. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or sub-bases.

E. Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum. See other sections of specification for additional requirements for excavating.

F. Store excavated material (temporarily) near excavation, in a manner that will not interfere with or damage excavation or other work. Do not store under trees (within drip line).

G. Retain excavated material that complies with requirements for backfill material. Dispose of excavated material that is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material. Remove unused material from project site, and dispose of in lawful manner.

3.6 BACKFILL MATERIALS:

A. For buried conduit or cable (other than below slab-on-grade, or concrete encased) - 2" thickness of well graded sand on all side of conduit or cable.

B. For trench backfill to within 6" of final grade - soil material suitable for compacting to required densities.

C. For top 6" of excavation - Top soil.

D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.

1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
2. Paved Areas, Other than Roadways (90 percent for cohesive soils, 95 percent for cohesionless soils).

E. Subsidence: Where subsidence is measurable or observable at electrical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.7 UTILITY COORDINATION:

A. Coordinate closely with Rocky Mountain Power (RMP) to finalize the conduit routing shown on the site plan. Verify all equipment dimensions and locations before beginning rough in. Consult all applicable contract drawings and latest RMP ESR to insure RMP code clearances required around all electrical equipment, trenching and burial depths, and identification requirements are met. Adjust locations of electrical work, boxes, outlets etc. As necessary to avoid obstructing electrical equipment or building appurtenances. Where job conditions

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require changes from the contract documents that do not change the scope of installation or nature of work required, the contractor will make such changes without additional cost to the owner. No other changes may be made without written permission of the owner.

B. Submit metering, main breaker, switchgear for approval prior to preconstruction.

C. Contractor to verify all phasing, voltages, and connections prior to energizing of electrical equipment.

1.1 CONCRETE BASES:

A. Unless otherwise noted, provide 4" high reinforced concrete bases for all floor mounted or floor standing electrical equipment, including generators, transformers, switchgear, battery racks, motor control centers, etc. Extend bases 6" beyond equipment or mounting rails on all sides or as shown on the drawings. Notwithstanding this requirement, coordinate with equipment manufacturer, shop drawings, and height of base to ensure compliance with NEC 404.8.

B. Concrete bases shall be provided under Divisions 26, 27 and 28. Coordinate size and location of all bases and furnish all required anchor bolts, sleeves, reinforcing and templates as required to obtain a proper installation.

C. Provide and locate properly sized concrete pads for power company furnished pad mounted transformers in accordance with power company clearance requirements. Where the serving utility is Rocky Mountain Power, the electrical contractor shall conform to the requirements of Electrical Service Requirements, Section 6.4.

1.2 ROOF PENETRATIONS:

A. Where raceways penetrate roofing or similar structural area, provide appropriate roof jack coordinate with the roofing contractor and the Architect in order to match the vent with the roof construction. The jack shall be sized to fit tightly to raceway for weather-tight seal, and with flange extending a minimum of 9" under roofing in all sides or as required by the roof type of construction. Completely seal opening between inside diameter of roof flashing and outside diameter of penetrating raceways. Coordinate all work with work required under roofing section of specifications.

1.3 FIRE PENETRATION SEALS:

A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. The fire rating of the penetration seal shall be at least that of the floor, wall or ceiling that it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs, and similar structures. Where applicable, provide 3M CID cast-in device for floor slabs. Where applicable, provide 3M fire barrier sealing penetration system, and/or IPC Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps, and other accessories as required. All materials to comply with UL 1479 (ASTM E-814). Comply with manufacturer's instructions and recommendations for installation of sealing fittings and barrier sealing systems.

1.4 PROJECT FINALIZATION AND START-UP:

A. Upon completion of equipment and system installation, assemble all equipment Factory Representatives and Subcontractors for system start-up.

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B. Each Representative and Subcontractor shall assist in start-up and check out their respective system and remain at the site until the total system operation is accepted by the Owner's representative.

C. The Factory Representative and/or System Subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:

1. This is to certify that the Factory Representative and System Subcontractor for each of the systems listed below have performed start-up and final check out of their respective systems.
2. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system.

SYSTEM	FACTORY REPRESENTATIVE
(List systems included)	(List name and address of Factory Representative)

Owner's Representative	Contractor

D. Send copy of acceptance to Architect/Engineer.

1.5 FINAL REVIEW:

A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

END OF SECTION 26 0500

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SECTION 260501

MECHANICAL / ELECTRICAL & OWNER PROVIDED EQUIPMENT COORDINATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Architectural, Structural, Vertical Transportation, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

1.2 CONTRACTOR RESPONSIBILITIES

A. Electrical Contractor shall verify electrical service provided prior to ordering any electrical equipment serving owner-provided equipment / mechanical equipment, and Electrical Contractor shall have the final responsibility for properly coordinating the electrical work, including the exact location, quantity and sizes of the electrical connection(s).

1. Circuit breakers, disconnects, starters, fuses, conduit sizes, wire sizes, VFDs, etc. have been coordinated by Engineers and sized according to the mechanical systems “Basis of Design”. Coordinate with Division 23 Contractor for any changes arising from substituted equipment or changes to the basis of design in any way. Coordinate all requirements of multi-motor VFD control (including fanwall units) and ensure all provisions accordingly. Prepare documentation showing changes in the electrical characteristics of each piece of equipment that has changed and submit for acceptance. All costs arising from said changes shall be the responsibility of Division 23.

B. Obtain submittals of all mechanical equipment from Division 21 through 23 contractor(s) as they are submitted to the design team.

1. Notify engineer of any modifications between contract documents and submittals. It shall be the contractor’s responsibility to ensure compliance with the documents.

C. Obtain submittals of all owner-provided equipment from Owner Representative prior to rough-in. It is not acceptable to proceed with the rough-in phase of work until this has been completed—if contractor elects to proceed they do at their own risk.

1. Notify engineer of any modifications between contract documents and submittals. It shall be the contractor’s responsibility to ensure compliance with the documents.

D. Electrical contractor shall be responsible for coordinating all their own blockouts and coordinating their space of a shared blockout.

E. Coordinate all interfaces between Mechanical and Electrical/Communications/Security Divisions before submitting any equipment for review or beginning installation.

1.3 ABBREVIATIONS

A. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who provides equipment and motor.

B. TC: Temperature Controls = Division 25 1000 Contractor who provides control.

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C. EC: Electrical Contractor = Divisions 26 through 28 Contractor who provides power/data.

D. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all equipment, motors, and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
AHU Interior Lights (Note 8)	MC	MC	MC	MC
AHU Light Switch	EC	EC	EC	EC
RTU Light Switch	MC	MC	EC	EC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4)				
-Separate	EC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
Variable Frequency Drives				
-Separate	EC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4)				
-Separate	MC	EC	EC	TC
-Factory Mounted and Wired	MC	MC	EC	TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	TC	MC or TC	EC (120V)	TC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	TC	MC or TC	TC	TC
Equipment in Temperature Control Panels	TC	TC	EC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	EC (120V)	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	MC & TC	MC & TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	FA	FA	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	EC	TC/FA

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ITEM -	Furnished Under	Set In Place Under	Power Wiring Under	Control Wiring Under
Relays for Fan Control via duct detectors (Note 5)	MC	EC	EC	FA
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	MC	EC	EC
Smoke Management Curtain and Shutters (Note 6)			EC	EC/FA
CO Sensors	FA	FA	EC	FA
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 7)	MC	MC	EC	FA
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC
Freezer and Refrigerator Temperature Controls (Intrusion/Access Controls)	MC	MC	EC	EC
Domestic Water Flow Switch Located downstream past the cooling tower. Provide 120V power. (Intrusion/Access Controls)	MC	MC	EC	EC
Low Building Temperature Sensor (Intrusion/Access Controls)	MC	MC	EC	EC
Ceiling Mounted Occupancy Sensors & VAV Box Integration (Note 8)	EC	EC	EC	TC
Single Restroom Cabinet Fans (Note 9)	MC	MC	EC	TC

B. Responsibility Schedule Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC.

2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.

3. Electrical contractor is responsible for wiring from starter to motor, unless factory wired.

4. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.

5. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.

   a. Division 26 and 28 shall provide all power and control wiring to fire/smoke and/or smoke dampers. Division 23 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.

   b. Fire alarm system shall override automated building control system during smoke exhaust mode.

   c. TC wiring required only when damper also serves HVAC system.

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6. FA wires from the fire alarm control panel necessary for the initiation and monitoring of the Smoke Management System Control Panel. TC wires to components and smoke control fans and dampers utilized in the control and monitoring of the Automated Building Control System.

    a. Provide 120V circuit and fire alarm connections to each curtain and shutter. Coordinate exact locations with curtain and shutter contractor.

7. Division 26 shall provide power to junction box on the exterior of the AHU and associated disconnect/starter or VAV. If required, division 26 shall wire individual fan arrays from overloads to motors as required.

8. Provide ceiling occupancy sensors with additional isolated relay with NO, NC and common outputs for use with HVAC control (VAV Boxes), data logging and other control options. TC to wire VAV to occupancy sensor contacts as required.

9. Ceiling mounted cabinet fans within single restrooms shall be switched on automatically with wall motion activated occupancy sensor. Provide in-line prewired relay, 120/208 to 277V AC, 24V AC/DC, 20A @ 277V to interface with ATC Controls and run fan. Both lights and fan to turn off 10-minutes after vacancy. TC to wire relay/contacts to ATC controls.

C. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trades requiring such power. Electrical contractor shall review Division 21 through 23 drawings and coordinate with said contractors to confirm power needs.

1. Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trades requiring the power.

    a. Such equipment is hereby defined as:

2. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing drawings (Division 22 work).

3. Dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor’s engineered system design drawings.

    a. Such equipment is hereby defined as:

    b. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing drawings (Division 22 work).

    c. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work, and will be shown by that contractor’s engineered system design drawings.

    d. Pre-action system alarm and trouble initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.

    e. Division 21 shall provide pre-action control panel and interconnection between pre-action panel and location of pre-action valve(s). See Specification 21-5000 for FM 200.

    f. Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).

4. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing

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drawings and schedules. Provide junction box and or receptacle as required by manufacturer.

5. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor's control submittal drawings.

6. Condensate pumps. Provide power from associated unit or from nearby panelboard.

7. BAS or Control System Gateways. Provide power from nearest panelboard and single data cable from nearest telecommunications room.

1.5 GENERAL REQUIREMENTS

A. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

B. Building Management System Controls:

1. Provide 120V circuit and single data cable to each building management control panel. Coordinate exact locations with controls contractor. See Specification 27-1500

2. Low voltage wiring from J-boxes to distributed control components, all low voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23.

3. Any additional power requirements shall be the responsibility of the Division 23 Contractor requiring same, and shall be provided at no additional cost to the owner.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.

2. Condensate piping.

3. Hydronic main piping (8" and larger).

4. Plumbing vent piping.

5. Supply, return and exhaust ductwork.

6. Cable tray systems.

7. Electrical conduit 4" diameter or greater.

8. Hydronic branch and mains (greater than 2", but less than 8").

9. Domestic water piping.

10. Fire sprinkler mains and leaders.

11. Hydronic branch piping (2" and less).

12. Domestic hot and cold-water branches.

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13. Electrical branch conduits.
14. Pneumatic control piping.
15. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2”).

C. Examine the contract documents of all trades (e.g. all Divisions 21 through 23 and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all electrical and communications equipment which require access for adjustment or servicing and which are in otherwise inaccessible locations. All access door locations must be approved by the architect prior to installation and be in as inconspicuous location as possible.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: replacement of drivers, fuses, etc.

1.7 BLOCKOUT USAGE

A. Electrical and Mechanical Contractors shall review the contract documents and advise if additional blockouts are necessary for the execution of work. Electrical and Mechanical Contractors shall coordinate and hold meetings with other contractors who will occupy the blockouts to ensure sufficient space is allocated for their scope of work. It is not acceptable to delay this meeting until conduit/piping/tray is being installed. Change orders are not acceptable due to a lack of contractor coordination prior to commencing rough in.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260501

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SECTION 26 0502

ELECTRICAL SUBMITTALS AND O & M MANUALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to all Division 26, 27 and 28 sections.

B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

C. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.2 SUBMITTAL REQUIREMENTS:

A. GENERAL:

1. After the Contract is awarded but prior to ordering, manufacture, or installation of any equipment, prepare complete Submittals including shop drawings, product data, brochures, etc. for materials and equipment as required by each section of the specification.
2. Review of Submittals shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Document's shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.
3. Submittals are reviewed, not approved. Comments made within submittals do not alter the contract documents in any way. The contractor is still responsible, regardless of comments (if any) made within submittals, for complying with drawings and specifications.
4. Notify engineer in writing if any of the comments noted in the submittals alter the contract cost. A comment within the submittal process which increases/decreases cost of product is not an authorization to the contractor under any circumstances to proceed.
5. Notify engineer of any modifications between contract documents and submittals. It is the responsibility of the contractor to ensure compliance.
6. ELECTRONIC SUBMITTAL REQUIREMENTS:
    a. Provide submittals in Portable Document Format (PDF).
    b. Documents must be electronically bookmarked and keyword searchable using Adobe Acrobat (http://www.adobe.com/acrobat) or Bluebeam Revu (http://www.bluebeam.com) for each relevant section. For example, include electronic bookmarks separating “Light Fixtures” from “Panelboards”.

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c. Electronically highlight all options for light fixtures, electrical equipment, etc. Manual highlighting and scanning of the documents is NOT acceptable and will NOT be reviewed.

d. Provide only completed cutsheets for all fixture and equipment types. Blank cutsheets submitted with a schedule are NOT acceptable and will NOT be reviewed.

e. At the time of submission, the electrical contractor shall provide a complete and comprehensive submission of all required specification sections/shop drawings at the same time. Exceptions may be given, with prior approval, for time-sensitive equipment.

f. A maximum of one submittal per specification section is allowed. It is NOT acceptable to provide a product by product submittal. Single product by product submittals will NOT be reviewed.

B. **PASSWORD AND SECURITY SETTINGS**

a. All default passwords for installed equipment shall be reprogrammed with owner-approved passwords and settings. The contractor shall coordinate with the owner to confirm specific password requirements prior to final programming. Ensure that all security settings are configured per the owner's instructions and industry best practices. Document all programmed passwords and provide secure delivery to the owner upon project completion. Unauthorized retention or reuse of passwords is strictly prohibited.

C. **SCHEDULING**

1. GENERAL

a. A minimum period of two weeks, exclusive of transmittal time, will be required each time Submittals are submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling submittal data.

b. If the shop drawings are rejected twice, the contractor shall reimburse the engineer the sum of $1,200.00 for the third review and any additional reviews required prior to commencement of the third review.

D. **QUALITY ASSURANCE**

1. PRE-SUBMITTAL PREPARATION

a. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to ensure proper clearance for installation of equipment.

b. Shop drawings requiring the use of electronic documents (floor plans, Lighting plans, fire alarm plans, etc.) shall be requested via a request for information (RFI) through the general contractor. Electronic documents will be provided to the Architect for distribution. No direct vendor requests will be accepted.

c. Contractor is completely responsible for the content of the submittal

2. SUBMITTAL REQUIREMENTS

a. Certifications shall be written or in the form of rubber stamp impressions as follows:

i. I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies in all respects with the requirements of the Contract Drawings and Specifications for this Project.

(Name of Electrical Subcontractor)

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Name_____.

Position_____Date_____.

b. Brochures to be submitted shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs that describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.

c. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Draftsmen skilled in this type of work. Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.

d. Observe the following rules when submitting the Shop Drawings and Brochures.

i. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included the submittal will be returned for resubmittal.

1. Submittal Identification shall include the following:

a. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted.

b. Original submittal numbers shall have the following format: “XXX-Y;” where “XXX” is the originally assigned submittal number and “Y” is a sequential letter assigned for resubmittals (for example, A, B, or C being the first, second, and third resubmittals, respectively). Submittal 25B, for example, is the second resubmittal of Submittal 25.

e. SPECIFICATION section and paragraph to which submittal applies.

E. POST-SUBMITTAL

1. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents.

1.3 PROVIDE SUBMITTALS AS REQUESTED FOR EACH OF THE SECTIONS LISTED BELOW:

A. 26 0519 Conductors and Cables

1. (600V and Below)

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a. Submit megohmmeter test data for circuits under 600 volts.

2. Conductors and Cables (Medium and Low Voltage)

a. Submit manufacturer's data on electrical cable and connectors for use above 600 volts. Upon request of Architect/Engineer, submit certificate of compliance indicating that cable has been tested in accordance with ICEA S-68-516, AE16 #6 and UL Standard 1072, and meets or exceeds minimum requirements.

b. Submit test data in accordance with IEEE Standard 400-2001 showing ambient conditions, voltage levels, level durations, and conduction current for each step. Include effective insulation resistance in submittal.

c. Submit medium voltage cable Splicer/Terminator certification of competency and experience 20 days before splices or terminations are made in medium voltage cables. Splicer/Terminator experience during the immediate past 3 years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.

B. 26 0526 Grounding

1. Submit the name of test agency to be used for testing specified in this section. Submit results of tests specified in this section. Also include test results in Operation and Maintenance Manuals as specified.

C. 26 0532 Conduit Raceway

1. Submit manufacturer’s data on Power & Control/Signal Cable.

D. 26 0533 Electrical Boxes and Fittings

1. Submit manufacturer’s data including specifications, installation instruction and general recommendations for each type of floor box used on project.

E. 26 0536 Raceway Systems

1. Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of raceway as follows: Surface Metal Raceways, Cable Tray Systems, Overhead metal raceways, Wire basket cable tray systems

2. Submit dimensioned drawings of raceway systems showing layout of raceways and fittings, spatial relationships to associated equipment, and adjoining raceways, for each type of raceway as follows: Surface metal Raceways, Cable Tray Systems, Overhead metal raceways, Wire basket cable tray systems

F. 26 0548 Electrical Seismic Control

1. A single submittal shall be provided for all seismic anchorage and restraints for all Division 26 equipment and systems provided as part of this project. Individual submittals for specific systems will not be accepted.

2. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

a. Complete engineering calculations and shop drawings for all seismic requirements for all equipment to be restrained as outlined in Section 26 0548 Specification, and as detailed on drawings.

b. The professional seal of the engineer who is responsible for the design of the Seismic Restraint System.

c. Details for all seismic bracing.

d. Details for steel frames, concrete inertia bases, and housekeeping pads.

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Include dimensions, embed depths, dowelling details, and concrete reinforcing requirements.

e. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors, snubbers, cables, and bolt connections.

f. Floor plan noting the locations, size, and type of anchorage and restraint to be used.

g. Include confirmation that all calculations are based on the design criteria listed in appropriate Section.

h. Certificate of Compliance.

i. Where equipment is exempt per this specification provide a written certificate of compliance for each of the systems noted with the professional seal of engineer who has reviewed the electrical system.

G. 26 0553 Electrical Identification

1. Submit manufacturer's data on each type of electrical identification products

a. Submit one sample of each component of the electrical identification system as follows: Wire/cable tape marker, Tags, Engraved, plastic laminate labels, Arc-flash hazard labels

H. 26 0573 Protective Device Study

1. Submit partial study that includes the calculated values for short circuit current availability and arc flash levels for each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, automatic transfer switch, and branch circuit panelboard. This data shall be submitted prior to, or at the same time as, submitting the entire electrical gear package. Contractor shall utilize construction drawings to estimate approximate feeder lengths for this preliminary submittal. Submitted data shall include equipment/panel designations, feeder conductor sizes, feeder lengths, and calculated short circuit values and arc flash levels. Include the utility transformer ratings and transformer impedances used for the preparation of the short circuit calculations.

2. Construction Period Submittal: During the construction period but prior to application of utility power to the electrical distribution system, submit an indexed copy of the complete protective device study based on actual field values. Include the following:

a. Introductory section with basic formulas, pertinent data, and rationale employed in the study.

b. One-line diagram for that portion of the system included in the study.

c. Calculations section showing tabulated calculations.

d. Results, recommendations, settings, etc.

3. Provide one revision to study based on engineering review comments for the completed study to allow for minor modifications to adjustable circuit breakers to minimize arc flash levels.

I. 26 0923 Occupancy Sensors

1. Submit manufacturer's data on occupancy sensors, control modules, wiring diagrams, interconnection diagrams and any related accessories.

2. Submit scaled drawings with lighting fixtures shown clearly marked by manufacturer showing proper product, location and orientation of each sensor.

J. 26 0943 Lighting Control Equipment

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1. Submit manufacturer's data on lighting control equipment including, but not limited to published catalog data sheets, rough-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
2. Meet with the electrical engineer at their office prior to preparation of shop drawings to discuss and verify specific programming and zoning requirements of system(s).
3. Meet with the lighting representative/manufacturer of the approved and accepted lighting control equipment to verify and understand specific installation requirements associated with that system.
4. Submit detailed drawings and documentation of lighting control components and interconnection including, but not necessarily limited to:
   a. Electronic controllers
   b. Control stations
   c. Photo sensors
   d. Occupancy sensors
   e. Network wiring details
   f. Input and output wiring details
   g. Lighting control panel load schedules
   h. Provide a complete sequencing and programming schedules for all devices, zones and scenes.
   i. Wallstations layouts
   j. Accurately scaled equipment layouts, wire/cable routing and connections to control wiring and electrical power feeders.

K. 26 1010 Energy & Power Metering System

1. Submit manufacturer's data on all components.
2. Submit riser diagrams and interconnection diagrams, wiring layouts etc. for advanced metering system including low voltage wiring interconnections; and communications and data line interconnections to system components and to the BAS/BMS (Building Automation System/Building Management System) equipment.
3. The external wiring interconnections required by the electrical contractor shall be clearly identified on the shop drawings.

L. 26 2200 Transformers

1. Submit manufacturer's data on transformers, including certification of transformer performance efficiency, percentage regulation at 100 percent and 80 percent power factor, no-load and full load losses in watts, percent impedance at 75 degrees C, hot-spot and average temperature rise above 40 degrees C ambient, sound level in decibels, and standard published data. Before submitting product data, verify that dimensions of units to be supplied allow proper code required clearances adjacent to unit.
2. Submit dimensioned drawings of transformer installations, showing layout, mountings and supports, and spatial relationship to proximate walls and equipment.

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3. For types and ratings required, furnish additional fuses, amounting to one unit for every five installed units, but not less than three units of each (including ELSP fuses when specified).

M. 26 2413 Switchgear and Switchboards

1. Submit manufacturer's data on switchgear and switchboards.
2. Submit dimensioned drawings of switchgear and switchboards showing accurately scaled basic sections including, but not necessarily limited to, auxiliary compartments, section components, and combination sections. Show plan view of equipment with dimensioned clearances to proximate equipment. Failure to submit said plan view shall not relieve contractor of responsibility to verify required clearances before release of equipment for fabrication.
3. Submit manufacturer’s data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2413 submittals received prior to submission of the preliminary protective device study will be REJECTED.
4. For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than 3 units of each.

N. 26 2416 Panelboards

1. Submit dimensioned drawings of panelboards and enclosures showing accurately scaled layouts of enclosures and required individual panelboard devices, including but not necessarily limited to, circuit breakers, fusible switches, fuses, ground-fault circuit interrupters, and accessories.
2. Submit manufacturer data including specifications, installation instructions and general recommendations, for each type of panelboard required.
3. Submit manufacturer’s data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2416 submittals received prior to submission of the preliminary protective device study will be REJECTED.

O. 26 2713 Service Entrance

1. Submit manufacturer's data on service-entrance equipment and accessories.
2. Submit dimensioned layouts of service-entrance equipment and spatial relationships to proximate equipment. Failure to submit said layouts shall not relieve contractor of responsibility to verify required clearances before release of equipment to fabrication.
3. Submit manufacturer’s data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2713 submittals received prior to submission of the preliminary protective device study will be REJECTED.
4. For types and ratings required, furnish additional fuses, amounting to one unit for every 2 installed units, but not less than one unit of each.

P. 26 2726 Wiring Devices

1. Submit manufacturer's data on electrical wiring devices.

Q. 26 2815 Overcurrent Protective Devices

1. Submit manufacturer's data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.
2. Submit layout drawings of overcurrent protective devices, with layouts of circuit breakers, including spatial relationships to proximate equipment. Failure to submit

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said spatial layouts does not relieve contractor of responsibility to verify all required clearances before release of equipment for fabrication.

3. Submit manufacturer's data and shop drawings only after completion of the preliminary protective device study (see Section 26 0573 as applicable). Any Section 26 2815 submittals received prior to submission of the preliminary protective device study will be REJECTED.

4. For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than two units of each size and type, unless specified otherwise in another section of these specifications.

5. Submit time-current trip curves (in log-log format) and trip setting parameter/range information (for each trip function) for all solid-state circuit breakers.

6. Manufacturer shall also provide recommended trip settings with the shop drawing submittal (including ground fault settings) for coordination with downstream overcurrent devices. Manufacturer shall base recommendations on the AIC rating of the electrical equipment.

7. Where the Protective Device Study specification section 260573 is included in the project, the time-current curves and recommended trip settings for all solid-state circuit breakers shall be submitted as part of the protective device study.

R. 26 2816 Motor and Circuit Disconnects

1. Submit manufacturer's data including specifications, installation and general recommendations, for each type of motor and circuit disconnect switch required.

2. Submit dimensioned drawings of electrical motor and circuit disconnect switches that have rating of 100 amperes and larger.

S. 26 2913 Motor Starters

1. Submit manufacturer's data on motor starters.

2. Submit dimensioned drawings of motor starters showing accurately scaled equipment layouts.

3. After installation is complete, including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage, amperage, service factor, and thermal heater size installed for each motor.

T. 26 2923 Variable Frequency Drives

1. Submit manufacturer's data on variable frequency drives.

2. Submit dimensioned drawings of variable frequency drive systems including, but not necessarily limited to, the following:

a. Complete data sheet.

b. Set of outline drawings giving complete mounting information, conduit entry and exit dimensions, over all unit dimensions, weights, physical characteristics, etc.

c. Set of complete electrical drawings for power and control wiring.

d. Manufacturer's literature giving detailed information of equipment being supplied including parts numbers, model numbers and ratings.

e. Harmonic Distortion Limits: The VFD systems shall produce no more than 12% current THD and no more than 3% voltage THD throughout the normal operating range as measured at the input terminals of each VFD system, on motors 10 HP and larger, provide harmonic filters. For motors less than 10 HP provide AC line reactors with a minimum of 3%

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impedance. VFD supplier shall submit with the approval shop drawings their harmonic control scheme and actual test results for the proposed scheme on at least three of their existing installations. Data shall clearly identify what equipment is proposed and demonstrate that it routinely meets harmonic limits above for the applications similar to this project. Prior approvals also require this data.

f. Shop drawings shall include interior view of VFD system enclosures with all components identified and located.

U. 26 3214 Emergency Power Inverter System

1. See Section for requirements.

V. 26 4313 Surge Protective Devices (SPD)

1. Submit manufacturer's data on SPD's listing all performance ratings specified or required herein.

2. Submit dimensioned drawings of SPD's including, but not necessarily limited to, the following.

a. Complete data sheet.

b. Set of outline drawings giving complete mounting information, conduit entry and exit locations and dimensions, overall unit dimensions, weights, physical characteristics, etc.

c. Set of complete electrical drawings for power and control wiring.

d. Manufacturer's literature giving detailed information of equipment including parts numbers, model numbers and ratings.

e. UL 1449 suppressed voltage rating documentation.

W. 26 5100 Interior and Exterior Building Lighting

1. Submit manufacturer's data on interior and exterior building lighting fixtures.

2. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in PDF format with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture catalog number and accessories clearly indicated on each sheet.

3. When applicable submit standard color samples with the shop drawings. If standard colors are not acceptable, a color sample will be provided to the fixture manufacturer. Return of the shop drawings will be delayed until color samples are provided.

4. Submit driver manufacturer cut sheets.

5. Submit a list of all lamps used on projects.

a. Stock of all spare items shall be delivered as directed to Owner's storage space. All components shall be labeled to match construction document nomenclature,

X. 26 5600 Exterior Area Lighting

1. Submit manufacturer's data on lighting units, including certified dimension drawings of components including, but not necessarily limited to, poles and standards, mast arms, brackets, hardware and fixtures.

Y. 27 1500 Structured Cabling Systems

1. Provide proof of RCDD certification and connectivity manufacturer certification.

2. Provide electronic submittals in Adobe PDF format within one file. Organize pages

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within submittal to be in the same order as the specification items (for example, racks prior to cabling). Where multiple submittals are provided due to submittal. If three or more reviews are required of the 27-1500 submittals, Contractor shall reimburse the Engineer for $1,200 before the Engineer will commence the third review. rejections/corrections, upon completing the submittal process with “No Exceptions Taken”, provide a consolidated single PDF submittal showing all products on the project.

3. Provide submittals for all racks/cabinets; patch panels, devices, cabling, firestopping solutions, tray, non-continuous cable support devices, grounding equipment, and miscellaneous equipment to be used on project. Where multiple part numbers are listed on a datasheet/cutsheet, highlight or circle applicable part.
4. Provide submittals showing complete racking layout in plan and elevation view to scale. Coordinate exact rack layout with Owner Information Technology Representative prior to submittal.
5. Provide color samples of all available standard color faceplates to architect.
6. Provide proposed labeling scheme for approval by owner/engineer.
7. Provide catalog cutsheets of all test equipment that will be used.
8. Provide results of all copper and fiber optic cable tests.

Z. 27 4100 Audiovisual Systems

1. Provide a list of finish options for selection. Do not order any equipment if finishes have not been selected on the shop drawings.
2. The following items shall be included in the shop drawings submittal:
    a. Project manager’s written proof, with signature and date, that shop drawings and/or brochure has been checked for accuracy prior to submittal. Shop drawings to comply in all respects with the requirements of the contract drawings and specifications for this project.
    b. A complete bill of materials, broken out per system type, for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.
        i. The bill of material is intended to be used to verify equipment within each system. Only one cut sheet per unique product type is required.
        ii. Example several systems may require the same flat panel display mount, that mount should be listed in each system type with only one (1) cut sheet provided for that product.
    c. Manufacturer’s data sheets and installation details for all devices, plates, cables and similar equipment. Product data showing multiple options, products and/or models shall be clearly marked identifying the specific options, products and/or models being provided.
    d. Signal flow drawings showing all audio, video, control, network and power connections required between all pieces of equipment within each system.
        i. Unique cable/wire identifier for each connection that correspond to field cabling labelling scheme.
        ii. All connections require connector type and male/female termination to be identified. Type shall correspond to a connector legend or shall be clearly identified per

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instance.

iii. Wiring pinouts for all multipin connectors used

iv. Detailed panel drawings showing wall, floor, rack, etc. input/output panel dimensions, connector types and text labeling for each connection shown

v. Physical location information for each device.

vi. Upon request AV Consult's signal flow drawings may be utilized for signal flow documentation within the shop drawings, provided, the items above are included. Contractor shall make request for electronic files as indicated in section 1.2.C.

e. Equipment rack elevations.

f. Matrix routing and preset configuration tables, and digital signal processing configuration details.

g. Wireless microphone transmission frequencies.

h. Submit all manufacturer training, 3rd party and/or organization certificates for each equipment and/or systems required for the implementation of this specification.

3. All touch panel layouts, page logic functions and control system functionality, shall be submitted and approved by the Owner and AV Consultant prior to installation and programming of the control systems. Contractor shall submit the following information at the following stages during the construction of the GUI.

a. Draft Stage: Draft drawings and/or sketches of; basic layouts, button details, text details and page flip progression. Include control schemes for all applicable devices in system.

b. Intermediate Stage: Intermediate Touch Panel Menus designed with manufacturer's software. Submit printouts and/or software files for review. Include detailed layouts, extensive control schemes for all controlled components, comprehensive button and text configurations, page flips and pop-up progression. Incorporate any changes or comments from previous stage mentioned above.

c. Demo Stage: Provide an active Touch Panel and controller to extensively demonstrate the operation of the control system. Demo of system shall be subject for review and considered as a deliverable. Include all revised detailed layouts, extensive control schemes for all controlled components, comprehensive button and text configurations, page flips and pop-up progression. Incorporate any changes or comments from the previous stage mentioned above.

d. Final Stage: Submit Final Touch Panel Menus designed with manufacturer's software. Submit printouts and software files for review. Include all detailed layouts, all revised control schemes for all controlled components, revised button and text configurations, page flips and pop-up progression. Include final page configurations for control of system from the touch panel. Incorporate any and all changes or comments from the previous stage mentioned above.

AA. 27 5123 Intercommunication Systems

1. Provide a complete bill of materials for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.

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2. Provide wiring layouts for Audio, Video, Control, and power.

BB. 28 2205 Access Control System

1. Submit manufacturer's data sheets including specifications, installation instructions, and general recommendation for each type of equipment specified.
2. Submit dimensioned drawings and schematics for design of system. Submit actual riser diagrams of complete system and elevations of required equipment. Typical risers are not acceptable.
3. Provide a complete bill of materials for all components, accessories, and hardware to be provided in order to assemble a complete and working system as described within the contract documents.
4. Submit dimensioned drawings and device wiring layouts for all equipment.
5. Submit equipment rack elevation diagrams (if applicable).
6. Submit network switch port count and power requirements. Port count and POE switch requirements should be broken out per EF/ER/TR closet.
7. Submit manufacturer certifications for all systems provided. Certifications must be from local office providing the install.
8. Provide battery calculations to verify system standby time are required.
9. Provide a detailed scope of work document for all services provided.

CC. 28 2300 Video Surveillance Systems

1. Provide a detailed scope of work document for all services provided.
2. Submit manufacturer certifications for all systems provided. Certifications must be from local office providing the install.
3. Product Data: Submit manufacturer’s data on closed circuit television and recording systems equipment including, but not limited to, cameras, lens selections, recording server, mid-span unit, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
4. Shop Drawings: Provide shop drawings showing:
    a. Equipment/device locations and connecting wiring of entire CCTV system. Locations of all cameras with custom painted enclosures due to wood ceilings.
    b. Include wiring diagrams and riser diagrams. Locations of all cameras, power supplies and controllers; point-to-point wiring diagrams for all devices. Include wiring diagrams for: cameras, environmental enclosures, pan-tilt-zoom mounts (if applicable); controllers; auxiliary devices.
    c. Submit equipment rack elevation diagrams (if applicable).
    d. Provide server calculations from Video Management System provider and camera manufacturer to validate proper server configuration and hard drive storage in submittals.
    e. Mid-span power budget calculations showing power requirements for all cameras.
    f. Submit network switch port count and power requirements. Port count and POE switch requirements should be broken out per IDF/MDF closet.
    g. Dimensioned drawings shall show design intent for this specific job. Typical riser diagrams are not acceptable.

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h.

5. Provide a complete bill of materials for all components, accessories, and hardware to be provided in order to assemble a complete and working system as described within the contract documents.

DD. 28 3111 Fire Alarm and Detection System

1. Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.

2. Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic. Shop drawings shall be prepared by an individual with a minimum NICET Level IV (Fire Protection Engineering/Fire Alarm Systems) certification. The individuals name and certification number shall be indicated on submittal design drawings.

3. Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.

4. Submit a complete set of documents to the Office of the State Fire Marshal containing the following information:

   a. A complete set of shop drawings indicating:

      i. Location of all alarm-initiating and alarm-signaling devices.

      ii. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.

   b. Wiring diagrams for:

      i. Alarm control panels.

      ii. Auxiliary function relays and solenoids.

      iii. Remote signaling equipment.

      iv. Standby battery calculations, including voltage drop calculation.

   c. A complete equipment list identifying:

      i. Type

      ii. Model

      iii. Manufacturer

      iv. Manufacturer catalog data sheets

      v. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)

   d. A complete zone list identifying all:

      i. Alarm-initiating and alarm-signaling devices.

      ii. Remote signaling and auxiliary function zones.

      iii. Specific devices associated with each zone.

   e. Sample “System Record Document”.

   f. Fire Alarm Key Plan Drawing showing the location of all device addresses

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and/or zones.

5. Address all comments from the Fire Marshal and instigate changes to the systems as applicable. Re-submit documents indicating changes instigated for final approval.

1.4 OPERATION & MAINTENANCE MANUALS

A. Provide operating instruction and maintenance data books for all equipment and materials furnished under this Division.

B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item. The binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones WLJ36544B). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.

C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet. (Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified).

D. Include the following information where applicable.

1. Identifying name and mark number.
2. Certified outline Drawings and Shop Drawings.
3. Parts lists.
4. Performance curves and data.
5. Wiring diagrams.
6. Light fixture schedule with the lamps and ballast data used on the project for all fixtures
7. Manufacturer's recommended operating and maintenance instructions.
8. Vendor's name and address for each item.

E. The engineer will review the manuals and when approved, will forward the manuals on to the architect. If the manuals are rejected twice, the contractor shall reimburse the engineer the sum of $1,200.00 for each review afterwards.

F. Provide high quality video and audio recording for all training sessions. All trainings shall be recorded by utilizing a pro-grade digital camera system. Utilize camera tripod and record audio directly at the presenter. Smartphone recordings are not allowed.

G. Provide Operation and Maintenance Manual information for each section listed below in addition to the general requirements listed above.

1. 26 0526 Grounding
   a. Test Results of measured resistance values
2. 26 0548 Electrical Seismic Control
   a. Certificate of Compliance from Final Inspection
3. 26 0923 Occupancy Sensors
   a. Record Drawings
      i. A complete set of ‘as-builts’ drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.

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ii. Provide a DIGITAL COPY to the owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:

1. CAD drawing files of 'as-built' lighting control components and point to point connections.
2. General configuration programming.
3. Job specific configuration programming to include schedule.
4. Tutorial file on complete programming of lighting control system.

4. 26 0943 Lighting Control Equipment

a. Record Drawings

i. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.

ii. Provide a DIGITAL COPY to the owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:

1. CAD drawing files of 'as-built' lighting control components and point to point connections.
2. General configuration programming.
3. Job specific configuration programming to include schedule.
4. Tutorial file on complete programming of lighting control system.

5. 26 2913 Motor Starters

a. After installation is complete, including water and air balancing, measure voltage (L-L and L-N) and full load current of each phase of each motor. Submit report showing field readings of voltage, amperage, service factor, and thermal heater size installed for each motor.

6. 26 2923 Variable Frequency Drivers

a. The vendor shall supply two complete manuals consisting of, as a minimum, general system arrangement, power wiring diagram, control wiring diagram, schematic of VFD System components and options, factory test reports, trouble shooting data, parts lists, and preventative maintenance information.

b. Prior to final acceptance, provide the engineer with two (2) copies of the harmonic distortion report. If the harmonics exceed the specified limits, VFD system will be rejected. The VFD vendor shall then have thirty (30) days to revise the harmonic control scheme and resubmit new shop drawings and new harmonic verification test reports for final acceptance.

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All costs resulting from non-compliance rejection, including additional engineer and contractor review time, will be paid by the VFD supplier.

7. 26 3214 Emergency Electrical System

   a. Manual Requirements

      i. Submit four complete sets of operating manuals for each item of equipment and/or component outlining the step-by-step procedure required for system start up, operation, and shutdown. Include the manufacturer's name, model number, and a description of all equipment, complete with basic operating features. Describe in detail all maintenance procedures and a troubleshooting guide listing possible breakdowns and repairs for each piece of equipment. Include all factory service manuals, complete parts lists, simplified schematic diagrams of each system as installed, and the original. Include complete rest reports specified in Section 26 3213.

8. 26 0943 Lighting Control Equipment

   a. Record Drawings

      i. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.

      ii. Provide a DIGITAL COPY to the owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:

         1. CAD drawing files of 'as-built' lighting control components and point to point connections.
         2. General configuration programming.
         3. Job specific configuration programming to include schedule.
         4. Tutorial file on complete programming of lighting control system.

9. 26 5100 Interior and Exterior Building Lighting

   a. The supply two complete manuals consisting of, as a minimum, general system arrangement, lighting cutsheets, schematic of System components and options, factory test reports, trouble-shooting data, parts lists, preventative maintenance information, and warranty contact information.

10. 27 1500 Telephone/Data System

    a. Test Results as outlined in Section 27 1500

    b. Manual shall include all service, installation, programming and warranty, including test results for each cable.

    c. Provide laminated plans (minimum size 11 x 17) of all telecommunications record drawings (including riser diagrams) in each and every EF, ER and TR.

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d. Record Drawings

i. The Owner shall provide electronic (DWG) format of telephone/data system drawings that as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.

ii. Provide a complete set of “as built” drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment within 30 working days of completion. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

11. 27 4100 Audiovisual System

a. Manual Requirements

i. Operating and maintenance manuals shall be submitted prior to testing of system. Total of two (2) manuals, shall be delivered to the Company. Manuals shall include all model numbers, service, installation, and programming information.

ii. Include all the following information:

1. Warranty
2. Network settings
3. Riser diagrams from Shop drawings
4. Training videos
5. USB Flash drive with programing source code and software editing programs

b. Record Drawings

i. The Owner shall provide electronic (DWG) format of AV System system drawings that as-built construction information can be added to. These documents will be modified by the AV contractor to denote as-built information as defined above and returned to the Owner.

ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

12. 275123 Intercommunications Systems

a. Manual Requirements

i. Operating and maintenance manuals shall be submitted prior to testing of system. Manuals shall include all model

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numbers, service, installation, and programming information.

ii. Include all the following information:

1. Warranty
2. Network settings
3. Riser diagrams from Shop drawings
4. Training videos
5. Flash drive with programing source code and software editing programs

b. Record Drawings

i. The Owner shall provide electronic (DWG) format of intercom System system drawings that as-built construction information can be added to. These documents will be modified by the intercom contractor to denote as-built information as defined above and returned to the Owner.

ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.

13. 28 2205 Access Control Systems

a. Manual Requirements

i. Provide (2) copies and a USB drive with the following:

1. All service, installation and programming information.
2. All model numbers, service, installation, and programming information.
3. Provide usernames and passwords within the O&M manual.
4. Locations of all panels, power supplies and controllers; point-to-point wiring diagrams for all devices.
5. Complete equipment list identifying: Type; model; manufacturer; manufacturer’s data sheets.
6. Network settings, including a list of IP and MAC addresses, username and passwords for network devices coordinated with door name and/or location.
7. Serial and model numbers for all major components.
8. Installation manuals and user manuals for all systems listed in these specifications.

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9. USB drive with any programming source code, drawing DWGs and PDFs, training videos
10. Installers and Manufacturer's Contact Information

b. Record Drawings

i. Locations of all panels, power supplies and controllers; point-to-point wiring diagrams for all devices.

ii. Complete equipment list identifying: Type; model; manufacturer; manufacturer's data sheets.

iii. Provide a complete set of CAD "AS-BUILT" Drawings showing installed wiring, wire paths, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system.

iv. A building map (2 copies) shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building security map adjacent to the security control panel. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD ~~security~~ Access Control drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various by the use of different colors (minimum of five colors).

14. 28 2300 Video Surveillance System

a. Manual Requirements

i. Provide (2) copies and a USB drive with the following:

1. All service, installation and programming information.
2. All model numbers, service, installation, and programming information.
3. Provide usernames and passwords within the O&M manual.
4. Locations of all panels, power supplies and controllers; point-to-point wiring diagrams for all devices.
5. Complete equipment list identifying: Type; model; manufacturer; manufacturer's data sheets.
6. Network settings, including a list of IP and MAC addresses, username and passwords for network devices coordinated with door name and/or location.
7. Serial and model numbers for all major components.
8. Installation manuals and user manuals for all systems listed in these specifications.
9. USB drive with any programming source code, drawing DWGs and PDFs, training videos

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10. Installers and Manufacturer's Contact Information

b. Record Drawings

i. Locations of all panels, power supplies and controllers; point-to-point wiring diagrams for all devices.

ii. Complete equipment list identifying: Type; model; manufacturer; manufacturer's data sheets.

iii. Provide a complete set of CAD "AS-BUILT" Drawings showing installed wiring, wire paths, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system.

c. A building map (2 copies) shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building security map adjacent to the security control panel. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD ~~security~~ Video Surveillance drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various by the use of different colors (minimum of five colors).28 3113 Fire Alarm and Detection System

d. Manual Requirements

i. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

e. Record Drawings

i. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.

ii. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).

iii. Provide a CD to the Owner containing the information specified below. The CD shall include all information required to allow the Owner to change the fire alarm program themselves. The CD shall contain a minimum of the following:

1. CAD drawing files of building fire alarm map.

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2. CAD drawing files of as-built fire alarm components and point to point connections.
3. General configuration programming.
4. Job specific configuration programming.
5. Tutorial file on complete programming of fire alarm system

15. 28 3113 Fire Alarm and Detection System

a. Manual Requirements

i. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

b. Record Drawings

i. A complete set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.

ii. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).

iii. Provide a CD to the Owner containing the information specified below. The CD shall include all information required to allow the Owner to change the fire alarm program themselves. The CD shall contain a minimum of the following:

1. CAD drawing files of building fire alarm map.
2. CAD drawing files of as-built fire alarm components and point to point connections.
3. General configuration programming.
4. Job specific configuration programming.
5. Tutorial file on complete programming of fire alarm system

END OF SECTION 26 0502

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SECTION 26 0507

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-23 section making reference to electrical connections.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical connection for equipment includes final electrical connection of all equipment having electrical requirements. Make final connections for all owner furnished equipment. See other applicable portions of specification for building temperature control wiring requirements.

B. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment; not work of this section.

C. Refer to Division-23 section for control system wiring; not work of this section.

D. Refer to Division-23 section for Snow/ice melting, Gutter and downspout snow/ice melting system wiring; not work of this section.

E. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE:

A. NEC COMPLIANCE: Comply with applicable portions of NEC as to type products used and installation of electrical power connections.

B. UL LABELS: Provide electrical connection products and materials that have been UL-listed and labeled.

PART 2 - PRODUCTS

2.1 GENERAL:

A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. Crimp on or slip-on type splicing materials (insulation displacement type) designed to be used without wire stripping are not acceptable. See Section 26 0532, Conduit Raceways; Section 26 2726 Wiring Devices: and Section 26 0519 Conductors and Cables for additional requirements. Provide final connections for equipment consistent with the following:

1. Permanently installed fixed equipment - flexible seal-tite conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.

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2. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).
3. Other methods as required by the National Electrical Code and/or as required by special equipment or field conditions.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.

C. Coordinate installation of electrical connections for equipment with equipment installation work.

D. Verify all electrical loads (voltage, phase, horse power, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report any variances from electrical characteristics noted on the electrical drawings to Architect before proceeding with rough-work. In summary, it is not in the Electrical Engineers scope to review the shop drawings from other trades/divisions.

E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.

F. Refer to basic materials and methods Section 26 0553 Electrical Identification, Conductors, for identification of electrical power supply conductor terminations.

END OF SECTION 26 0507

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SECTION 26 0510

ELEVATOR ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Architectural, Structural, Vertical Transportation, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.

C. Elevator Shop Drawings.

1.2 DESCRIPTION OF WORK:

A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete/operating/code compliant electrical system.

B. Carefully review elevator shop drawings prior to ordering elevator disconnects. Confirm physical dimensions of disconnect fit within enclosure (if provided) from elevator manufacturer. Review elevator shop drawings prior to ordering disconnect. Notify engineer in writing immediately, should any discrepancy occur. Confirm voltage and phase of equipment and compare with electrical drawings.

C. Coordinate the installation with the elevator manufacturer, including the sequencing of the electrical installation.

D. Anticipated 11-HP 480V/3P/60hz Electrical Specifications.

1. Machine Roomless Elevator
2. No generator backup power connection. Manufacturer to provide Battery lower system as required.
3. Coordinate the exact location of disconnect and extend power accordingly.
4. Provide required data lines to new elevator as required.

1.3 QUALITY ASSURANCE:

A. Coordination: All electrical equipment placement and installation shall be coordinated with the elevator contractor and shall not be located until elevator equipment is installed or coordination has been arranged with elevator contractor’s equipment placement.

B. Regardless of whether shown on drawings:

1. All electrical equipment, located less than 1225 mm (48 in.) above the pit floor, shall be weatherproof (NEMA 4X) and have wiring identified for use in wet locations in accordance with the requirements in NFPA 70.
2. Receptacles:
   a. Provide one 120V/20A dedicated GFCI receptacle in <u>each</u> elevator machine rooms, machinery spaces and elevator pit areas. Provide an additional 120V/20A dedicated receptacle in the pit for a sump pump. Any receptacle installed in pits, machinery spaces, or elevator car tops shall be GFCI. Exception: Sump pump shall not require GFCI protection.
   b. Provide one GFCI receptacle located at the top of the hoistway and machine room.

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3. Clearances around all electrical equipment in the elevator machine room shall comply with NEC 110-26 electrical clearances requirements. The electrical contractor's work and equipment placement shall be coordinated with the elevator contractor's equipment placement.

4. All electrical piping runs provided by the electrical contractor and elevator contractor to the elevator equipment shall be run overhead or in a manner which does not restrict access to and around any equipment.

5. Lighting:

    a. Elevator Pits:

        i. Provide light fixture and light switch at the pit.

        ii. The location shall be determined after coordination with the elevator contractor so that the light fixture is located out of the way of all elevator equipment.

        iii. Sub-Pit Light fixture and Light Switches (when present): If there is more than one level of an elevator pit, a three-way switch shall be provided in both the pit areas to operate a light fixture located in both locations. A light fixture shall be installed in each pit level. Both light fixtures shall be wired so that they both operate at the same time by light switches at both pit levels.

        iv. The switch shall be a minimum of 18 inches above the elevator lowest landing doorsill and adjacent to (not behind) the pit access ladder.

        v. The elevator pit shall have a separate branch circuit supplying pit lighting and receptacle(s) and another for the pit sump pump.

    b. Elevator Machine Rooms:

        i. Light switches shall be required in all elevator machine rooms adjacent to the jamb side of the machine room entry door.

        ii. A separate branch circuit shall supply the elevator machine room space lighting and receptacles.

        iii. Provide 200 Lux (19FC) light level measured at the floor level.

    c. Elevator Cars:

        i. Provide a separate branch circuit to supply the car lights, receptacle(s), auxiliary lighting power source, and ventilation on each elevator car. It shall be lockable and shall be supplied in all elevator machine rooms. One disconnect required for each elevator. A label stating the location of the supply side overcurrent protection device is required on the disconnect.

    d. Hoistway:

        i. Provide light fixture every 1.5 stories within the hoistway and at the top of the hoistway if elevator disconnect is mounted on the elevator cab.

6. Fire Alarm:

    a. Provide a smoke detector and heat detector within each elevator hoistway.

    b. Provide a smoke detector and heat detector in machine room.

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c. Provide a heat detector within the space that houses the elevator controller. Heat detector to activate shunt trip and be located within 24" of the sprinkler head.

d. For each group of elevators, provide a normally closed contact representing the smoke detector at the designated return landing.

e. For each group of elevators, provide a normally closed contact representing all smoke detectors located in lobbies, hoistways, or machine rooms / machine space, but not the smoke detector at the designated return landing or the smoke detectors as described in i. and ii. below:

i. If a smoke detector is located in the hoistway at or below the lower of the two recall landings, it shall be wired to activate the same normally closed contact as the smoke detector located in the lobby at the lower of the two recall landings.

ii. If machine rooms / machine space is located at the designated return landing, the smoke detectors located therein shall be wired to activate the same normally closed contact as the smoke detector at the designated landing.

f. Requirements for intermittently illuminating the fire hat visual signal in the car operating panel, either i. or ii. apply.

i. For a single unit or for a group of elevators having one common machine room / machine space and one common hoistway, provide one additional normally closed contact representing the machine room / machine space and hoistway smoke detectors.

ii. If the group contains more than one hoistway and hoistway smoke detectors are installed, or if the group has more than one machine room / machine space, provide one normally closed contact for each elevator. The contact is to represent the smoke detector in the machine room / machine space for that particular elevator, and any smoke detectors in the hoistway containing that particular elevator.

g. If sprinklers are installed in the hoistway or machine room / machine space(s), a means to automatically disconnect the mainline power supply to the affected elevator and any other power supplies used to move the elevator, upon or prior to the application of water is required and shall be provided (unless prohibited by local code). Smoke detectors shall not be used to activate sprinklers in hoistways or machine rooms / machine spaces or to disconnect the mainline power supply.

h. Heat sensors used to automatically disconnect the mainline power supply prior to the application of water from sprinklers shall be provided with a normally closed contact with wiring from the sensing device to a controller designated by Elevator Manufacturer / Elevator Equipment Installer. The normally closed contact shall be closed when the heat sensor is not activated and shall be open when the heat sensor is activated.

7. Sump Pumps:

a. Provide (1) 120V receptacle on a dedicated 20A circuit in each elevator pit for the elevator sump pump.

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8. Elevator Main Disconnect:

   a. Provide in all elevator machine rooms in sight of elevator motor and controller and adjacent to machine room entry door, one disconnect required for each elevator. Provide a label on the disconnect stating location of overcurrent protection device.

   b. Hydraulic Elevator Only: Main Line Disconnect Auxiliary Contact for Emergency Battery Lowering Operation: This item is provided by the electrical contractor within the main line disconnect: If an emergency lowering system is utilized on a hydraulic elevator, there shall be an auxiliary contact associated with the main line disconnect.

   c. Shunt Trip Required When Sprinklers are Present: Electrical contractor shall provide a shunt trip for the elevator main line power in order to remove power from elevator controls before any sprinkler is activated in the elevator machine room and hoistway overhead. The shunt trip shall be installed in the elevator machine room.

9. Emergency Power Requirements:

   a. Provide the emergency (standby) power unit and means for starting it, and deliver to the elevator via disconnect switches in the machine room / machine space, sufficient power to operate one or more elevators at a time at full rated speed and rated load.

   b. Provide an Automatic Power Transfer Switch for each power feeder to monitor both Normal and Emergency (Standby) Power conditions and to perform the transfer from one to the other. Switch shall have two sets of normally closed dry contacts, one to be open when the switch is in the Emergency (Standby) Power position, the other to open upon initiation of power transfer and to close when transfer is complete. Switch shall have an inhibit function which will delay transfer to Normal and / or Emergency (Standby) Power by an adjustable period of 0 -300 seconds. Switch shall have a Phase Monitor feature, which prohibits the transfer of power between "live" sources unless the sources are in phase with each other. If a Shunt Trip device is provided, an additional Normally Closed contact is required from the Emergency (Standby) Power source.

10. Emergency Phone and Data Line: Provide (2) ¾" conduits from the communications utility to each elevator machine room / elevator controller. Electrical contractor shall provide electrical conduit for both the emergency elevator phone and required data line to the elevator machine room, to the elevator controller, and terminated on the elevator controller with coordination from the elevator contractor.

11. Provide copper elevator feeder conductors and grounding conductors.

1.4 SUBMITTALS

A. Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 ELEVATOR DISCONNECTS:

A. GENERAL:

1. Provide Power Module Switch in a single NEMA enclosure with all necessary relay(s), control transformer and other options (as listed below), and as shown on drawings. The Power Module Switch shall have an ampere rating as required in the elevator shop drawings, and shall include a horsepower rated fusible switch with shunt trip capabilities.

2. The amp rating of the switch shall be based upon elevator manufacturer

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requirements and utilize Class J Fuses. It shall include a 100VA control power transformer with primary and secondary fuses. Unit shall also contain an isolation relay (3PDT, 10 amp, 120V). A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid.

3. Provide the following additional features:

   a. Key to Test Switch

   b. “ON” Green Pilot Light

   c. If elevator is hydraulic, provide 1P NC Mechanically Interlocked Auxiliary Contact.

   d. Fire Alarm Voltage Monitoring Relay (Needed to comply with NFPA 72)

   e. NEMA enclosure appropriate for the environment installed.

   f. All switches shall have shunt trip capabilities at 120Vac from remote fire safety signal.

B. ACCEPTABLE MANUFACTURER:

1. Manufacturer: Subject to compliance with requirements. Provide elevator-disconnect of one of the following:

   a. Bussman Quick-Spec Power Module Switch Elevator Disconnect.

   b. Littlefuse LPS Series Elevator Disconnect.

PART 3 - EXECUTION

A. Install disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches used with motor driven appliances, and motors and controllers within sight of controller position.

D. Grounding: Grounding shall be supplied from the elevator main line disconnect and controller to the upstream panel and building ground. Ground wire shall be the same size as phase wires to minimize electrical noise interference.

E. Non-elevator related piping and equipment is prohibited in the machine room or hoistway.

END OF SECTION 26 0510

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SECTION 26 0519

CONDUCTORS AND CABLES (600V AND BELOW)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to conductors and cables specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.

B. Types of conductors and cables in this section include the following:

1. Copper Conductors (600V)
2. Aluminum Conductor (600V)
3. 0-10V Class 1 Circuits

C. Applications for conductors and cables required for project include:

1. Power Distribution
2. Feeders
3. Branch Circuits
4. 0-10V Class 1 Circuits

1.3 RECORDS SUBMITTAL:

A. Submit record in triplicate of megohmmeter readings to Architect/Engineer. Please see paragraphs 3.2A AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW for testing requirements.

1.4 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables that have been UL-listed and labeled.

B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.

C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

1.5 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 COPPER AND ALUMINUM CONDUCTORS (600V):

A. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated for each service. Where not indicated provide proper selection to comply with project's

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installation requirements and NEC standards. Provide conductors in accordance with the following:

1. Service Entrance Conductors – Copper/Aluminum conductor; see drawings for insulation type.
2. Distribution and Panelboard Feeders; and Other Conductors, #2 AWG and Larger – Copper/Aluminum conductor; see drawings for insulation type.
3. Branch Circuit Conductors and All Conductors #3 AWG and Smaller - Copper conductor, stranded, with THHN/THWN insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG.
4. Aluminum Conductors. Where aluminum conductors are specified for use, provide compact stranded Aluminum Association 8000- series alloy conductor material.
    a. Stabiloy - Alcan Cable
    b. Triple E - Southwire

B. Provide connectors and terminations for aluminum-alloy conductors of hydraulic compression type only, listed under UL 486-B, and marked "AL 7CU" for 75o rated circuits, and "AL9CU" for 90o rated circuits.

C. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.

D. Provide neutral and ground wire as specified elsewhere in documents.

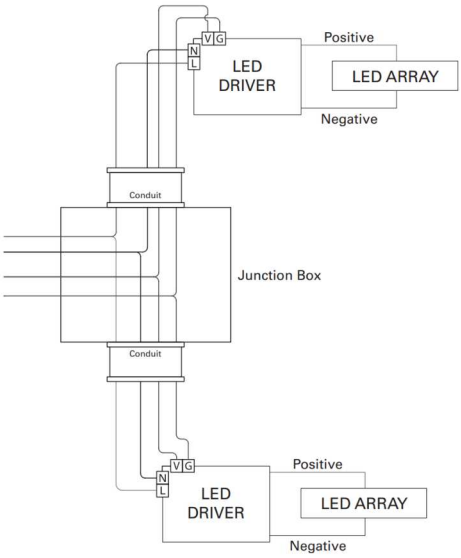
E. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

2.2 COPPER LOW VOLTAGE CONDUCTORS (0-10V CIRCUITS):

A. 0-10V Class 1 Circuits:

1. General:
    a. Provide Class 1 circuits for all 0-10V dimming installations. Class 1 circuits shall be permitted to be installed with other circuits as specified in NEC 725.48 (A) and (B):
        i. Class 1 circuits shall be permitted to occupy the same cable, cable tray, enclosure, or raceway without regard to whether the individual circuits are alternating or direct current, provided all conductors are insulated for the maximum voltage of any conductors in the cable, cable tray, enclosure or raceway.
        ii. Class 1 circuits shall be permitted to be installed with power supply conductors as specified:
            1. Class 1 and power supply circuits shall be permitted to occupy the same cable, enclosure, or raceway only when functionally associated.
        iii. Utilize VIOLET and PINK copper conductors, with THHN/THWN insulation.

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PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation", and in accordance with recognized industry practices.

B. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.

C. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved swivel connection. Nonmetallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop that pull wires can be attached; remove insulation from conductors before forming the loop. Larger sizes of cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.

D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.

E. Pull in cable from the end having the sharpest bend; i.e. bend shall be closest to reel. Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.

F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.

G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.

H. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and that is listed by UL.

I. Seal all cable ends unless splicing is to be done immediately. Conduit bodies shall not contain splices.

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J. Support all cables in pullholes, concrete trenches, and similar locations by cable racks and secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator. In manholes, pullholes, concrete trenches, and similar locations, wrap strips of fire-proofing tape (approx. 1/16 inch thick by 3 inches wide) tightly around each cable spirally in half-lapped wrapping or in two butt-joined wrappings with the second wrapping covering the joints in the first. Apply tape with the coated side toward the cable, and extend tape one inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure sensitive glass cloth tape. Provide fireproofing tape of a flexible, conformable fabric having one side coated with flame retardant, flexible, polymeric coating and/or a chlorinated elastomer not less than 0.050 inch thick weighing not less than 2.5 pounds per square yard. Provide tape that is noncorrosive to cable sheath, self-extinguishing, and that will not support combustion. Construct tape of materials that do not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

K. Follow manufacturer's instructions for splicing and cable terminations.

3.2 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW:

A. Prior to energization, test cable and wire for continuity of circuitry, and for short circuits, Megger all circuits of 100 amp and greater rating. Correct malfunctions. Record all test data and provide written test report.

B. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements.

3.3 IDENTIFICATION OF FEEDERS: Refer to Section 26 0553 for requirements.

END OF SECTION 26 0519

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SECTION 26 0526

GROUNDING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide grounding as specified herein, and as indicated on drawings.

B. Provide grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, and items required by the NEC to provide a permanent, continuous, low impedance, grounding system.

C. Unless otherwise indicated, ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, and equipment in accordance with all code requirements.

D. Ground each separately derived system, as described in NEC Section 250-30, unless otherwise indicated.

E. Types of grounding in this section include the following:

1. Underground Metal Water Piping
2. Metal Building Frames
3. Grounding Electrodes
4. Grounding Rods
5. Separately Derived Systems
6. Service Equipment
7. Enclosures
8. Systems
9. Equipment
10. Other items indicated on drawings

F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products that have been UL listed and labeled.

B. Resistance from the service entrance ground bus, through the grounding electrode to earth, shall not exceed 5 ohms.

1.4 SUBMITTALS:

A. Submit the name of test agency to be used for testing specified in this section. Submit results of tests specified in this section. Also include test results in Operation and Maintenance Manuals as specified.

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PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS:

A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

B. ELECTRICAL GROUNDING CONDUCTORS: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. Provide with green insulation.

C. GROUND RODS: Steel with copper welded exterior, 3/4" dia. x 10' long. Weaver or Cadweld.

D. GROUND WELL BOXES FOR GROUND RODS: Precast concrete box 9-1/2" W. x 16" L. X 18" D. with light duty concrete cover for non-traffic areas or rated steel plate for traffic areas. Provide covers with lifting holes. Engrave cover with "GROUND ROD".

E. CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND): #2/0 AWG bare copper conductor.

F. INSULATED GROUNDING BUSHINGS: Plated malleable iron body with 150 degree Centigrade molded plastic insulating throat, lay-in grounding lug with hardened stainless steel fasteners, OZ-Gedney BLG, or Thomas & Betts #TIGB series.

G. CONNECTIONS TO PIPE: For cable to pipe, OZ-Gedney G-100B series or Thomas & Betts #390X series, or Burndy type GAR.

H. CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS, OR SPLICES: For splicing and/or connecting conductors, use exothermic welds or high pressure compression type connectors. Provide exothermic weld kits manufactured by Cadweld or Thermoweld. If high compression type connectors are used for cable-to-cable, or cable-to-steel, or cable-to-ground rod connections, provide Thomas & Betts #53000 series, or Burndy Hyground series.

I. BONDING JUMPERS: OZ-Gedney Type BJ, or Thomas & Betts #3840 series, or Burndy type GG and type B braid.

J. INTERSYSTEM BONDING TERMINAL: Provide one 12” L. x 2” H x ¼” thick copper bus bar. Mount on wall adjacent to Main Electrical Service Equipment on insulating standoffs, 18” A.F.F. Furnish complete with lugs for connecting systems grounding cables. All holes shall be drilled for 2 hole compression lugs. Provide 6 spare lugs. Connect to equipment grounding bus in Main Electrical Service Equipment with No. 4 AWG copper conductor.

PART 3 - EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS:

A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.

B. Install clamp-on connectors only on thoroughly cleaned and metal contact surfaces, to ensure electrical conductivity and circuit integrity.

C. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All non-metallic raceways shall include copper grounding conductor sized in accordance with NEC. Include copper grounding conductor in all raceway installed in suspended slabs.

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D. Provide service entrance grounding by means of ground rods (quantity of two, driven exterior to building), by means of bonding to water main, and by means of bonding to building structural steel. In addition, provide a grounding electrode for not less than 30 lineal feet in concrete footing or foundation that is in direct contract with earth. Size electrode in accordance with NEC, but in no case, smaller than No. 4 AWG bare copper. Support electrode so as to be below finished grade near the bottom of the trench, and approximately three inches from the bottom or sides of the concrete. Locate a point of connection for inspection.

E. Provide grounding conductors for dimming systems in accordance with manufacturer's requirement.

3.2 GROUNDING ELECTRODES:

A. Concrete Encased Grounding Electrode (UFER Ground): Provide a #2/0 AWG minimum bare copper conductor encased along the bottom of concrete foundation or footings that are in direct contact with the earth and where there is no impervious water-proofing membrane between the footing and the soil. Extend electrode through a horizontal length of 30 feet minimum and encase with not less than 2 nor more than 5 inches of concrete separating it from surrounding soils. At point of emergence from concrete, run electrode through a protective non-metallic sleeve and extend to the main building [reference] ground bus.

B. [Supplementary Grounding Electrode (Ground Ring, Grid, and Driven Rods): Provide driven ground rod(s) installed in listed ground well box(s) and filled with gravel after connection is made. Interconnect ground rod(s) with structural steel and adjacent rods with minimum #4 AWG bare copper conductor. Locate ground rod a minimum of 10 feet from any electrode of another electrical system or from adjacent ground rod(s)].

C. Separately Derived Electrical System Grounding Electrode: Ground each separately derived system per requirements in NEC Section 250-26 unless indicated otherwise.

D. GROUNDING ELECTRODE CONDUCTOR: Provide grounding electrode conductor sized per NEC table 250-94 or as indicated.

E. POWER SYSTEM GROUNDING: Connect the following items using NEC sized copper grounding conductors to lugs on the Main Building Ground Bus

1. Grounding electrode conductor from concrete encased electrode, and from ground rods.
2. Conductor from main incoming cold water piping system.
3. Conductor from building structural steel.
4. Ground for separately derived systems.

F. Run main grounding conductors exposed or in metallic conduit if protection or concealment is required.

G. EQUIPMENT BONDING/GROUNDING: Provide a NEC sized conductor, whether indicated or not on the drawings, in raceways as follows:

1. Non-metallic conduits and ducts.
2. Distribution feeders.
3. Motor and equipment branch circuits.
4. Device and lighting branch circuits.
5. Provide grounding bushings and bonding jumpers for all conduit terminating in reducing washers, concentric, eccentric or oversized knockouts at panelboards, cabinets and gutters.

H. Provide bonding jumpers across expansion and deflection couplings in conduit runs, across pipe connections at water meters, and across dielectric couplings in metallic cold

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water piping system.

I. Provide bonding wire in all flexible conduit.

3.3 TESTING:

A. Obtain and record ground resistance measurements both from service entrance ground bus to the ground electrode and from the ground electrode to earth. Install additional bonding and grounding electrodes as required to comply with resistance limits specified under this Section.

B. Include typewritten records of measured resistance values in the Operation and Maintenance Manual.

C. Use independent testing agency for all testing.

D. Use test equipment expressly designed for the purpose intended. Submit name of testing agency for review and approval, in writing, to the Engineer prior to the performance of any testing.

END OF SECTION 26 0526

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SECTION 26 0529

SUPPORTING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification section, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to supports, anchors, sleeves, and seals, specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of supports, anchors, and sleeves is indicated by drawings and schedules and/or specified in other Division-26 sections. See Section 260532, Raceways, for additional requirements.

B. Work of this section includes supports, anchors, sleeves and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hole conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, threaded rods and all associated accessories.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies". Provide electrical components that are UL-listed and labeled.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES:

A. GENERAL:

1. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawings for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES:

A. Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. For pre-and post tensioned

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construction, use pre-set inserts for support of all electrical work. Do not use toggle bolts, moly bolts, wood plugs or screws in sheetrock or plaster as support for any equipment or raceway.

D. Independent support wires are not allowed as indicated as per NEC 300.11(B).

E. RACEWAYS:

1. Support raceways that are rigidly attached to structure at intervals not to exceed 8 feet on center, minimum of two straps per 10 foot length of raceway, and within 12" of each junction box, coupling, outlet or fitting. Support raceway at each 90° degree bend. Support raceway (as it is installed) in accordance with the following:

NUMBER OF RUNS	3/4" TO 1-1/4" 0	1-1/2" & LARGER 0
1	Full straps, clamps or hangers.	Hanger
2	Full straps, clamps or hangers.	Mounting Channel
3 or more	Mounting Channel	Mounting Channel

2. Support suspended raceways on trapeze hanger systems; or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use "tie wire" as a portion of any raceway support system; do not support raceway from ceiling support wires.

F. FLOOR MOUNTED EQUIPMENT:

1. Provide rigid attachment of all floor mounted equipment to the floor slab or structural system. Provide 5/8" bolts or expansion anchors at each 90 degree corner and at intervals not to exceed 48" on center along entire perimeter of the equipment. Provide rigid attachment for all floor mounted switchboards, panelboards, power and control equipment, motor control centers, dimmer cabinets, transformers (provide neoprene vibrations isolators at anchor points), oil switches, battery packs and racks, and similar equipment furnished under Division 26, 27 and 28.

G. WIREWAYS, BUS DUCTS AND CABLE TRAYS:

1. Provide vertical and lateral support systems for all wireways, busway, and cable trays that are supported from overhead structure. See Sections 260536 and 262500 for additional requirements.

END OF SECTION 26 0529

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SECTION 26 0532

CONDUIT RACEWAY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways and specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of raceways is indicated by drawings and schedules.

B. Division-26 is responsible to provide conduit and rough-in for all thermostat controls located within walls. Coordinate with the Controls Contractor and verify exact location of all thermostats. Obtain and review submittals of Temperature Control Equipment from Controls Contractor and Divisions 21-23.

C. Types of raceways in this section include the following:

1. Electrical Metallic Tubing
2. Flexible Metal Conduit
3. Intermediate Metal Conduit
4. Liquid-tight Flexible Metal Conduit
5. Rigid Metal Conduit
6. Rigid Non-metallic Conduit

1.3 QUALITY ASSURANCE:

A. MANUFACTURERS: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. STANDARDS: Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.

1.4 SUBMITTALS:

A. Not Required.

PART 2 – PRODUCTS

2.1 METAL CONDUIT AND TUBING:

A. GENERAL:

1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".

B. RIGID METAL CONDUIT (RMC): FS WW-C-0581 and ANSI C80.1.

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C. INTERMEDIATE STEEL CONDUIT (IMC): FS WW-C-581.

D. PVC EXTERNALLY COATED RIGID STEEL CONDUIT: ANSI C80.1 and NEMA Std. Pub. No. RN 1.

E. ALUMINUM CONDUIT: Not acceptable.

F. ELECTRICAL NON-METALLIC TUBING (ENT) SYSTEM: Not acceptable.

G. MC CABLE: Only acceptable as indicated below.

1. MC Cable is acceptable for all branch circuits installed in gypsum wallboard walls from the home run device box to the last device box on the branch circuit and all boxes in between, from the home run device box to the branch panel, the circuit shall be installed in an approved raceway. **All MC Cable shall be provided with anti-short fittings.**

2. MC Cable is acceptable for all light fixture whips not longer than six feet in length. Located in removable grid ceilings. MC Cable is unacceptable to be installed from light fixture to light fixture. **All MC Cable shall be provided with anti-short fittings.**

   a. The use of MC-PCS cable is acceptable for light fixture whips utilizing 0-10v control schemes, not longer than 72” in length, located above removable grid ceilings. All MC cable shall be provided with anti-short fittings.

      i. Acceptable Manufacturers

         1. AFC – MC Luminary Cable
         2. Encore – MC-LED Lighting Cable
         3. Southwire – MC-PCS Duo

3. Before any rough-in of MC cable, the contractor shall conduct a on-site meeting with owner and engineer to review standards and overall rough-in requirements. Contractor shall conform to all owner and engineer requirements.

4. Contractor mock-up one classroom for review of electrical installation prior to continuing installation of MC cabling.

H. RIGID AND INTERMEDIATE STEEL CONDUIT FITTINGS:

1. Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.

I. ELECTRICAL METALLIC TUBING (EMT): FS WW-C-563 and ANSI C80.3.

J. EMT FITTINGS:

1. Provide insulated throat nylon bushings with non-indenter type malleable steel fittings at all conduit terminations. Install OZ Type B bushings on conduits 1" larger. Cast or indenter type fittings are not acceptable.

K. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type;

1. Zinc-coated steel.

L. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 1, and Style A.

M. LIQUID TIGHT FLEXIBLE METAL CONDUIT:

1. Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).

N. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3,

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Style G.

O. EXPANSION FITTINGS: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS:

A. GENERAL:

1. Provide non-metallic conduit, ducts and fittings of types, sizes and weights as indicated; with minimum trade size of 3/4".

B. UNDERGROUND PVC PLASTIC UTILITIES DUCT:

1. Minimum requirements shall be schedule 40 for encased burial in concrete and for Type II for direct burial.

C. PVC AND ABS PLASTIC UTILITIES DUCT FITTINGS:

D. ANSI/NEMA TC 9, match to duct type and material.

E. HDPE CONDUIT: Not acceptable.

2.3 CONDUIT; TUBING; AND DUCT ACCESSORIES:

A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, that mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 SEALING BUSHINGS:

A. Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

2.5 CABLE SUPPORTS:

A. Provide OZ cable supports for vertical risers, type as required by application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with the following:

1. SERVICE ENTRANCE CONDUCTORS, AND CONDUCTORS OVER 600 VOLTS:

a. Install in rigid metal conduit (RMC), or intermediate metal conduit (IMC); except where buried below grade, install in non-metallic conduit or duct, individually encased in concrete. See duct banks.

2. FEEDERS UNDER 600 VOLTS:

a. Install in electric metallic tubing (EMT). Below concrete slab-on-grade or in earth fill, install in non-metallic plastic conduit. In areas exposed to weather, moisture, or physical damage, install in RMC or IMC. In suspended slabs, install in EMT (NOT APPROVED).

3. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS:

a. Install in electric metallic tubing (EMT). Below concrete slab-on-grade or in earth fill, install in non-metallic plastic duct. In areas exposed to weather, moisture, or physical damage, install in RMC or IMC. In suspended slabs, install in EMT (NOT APPROVED).

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4. UTILITY COMPANY COORDINATION:

   a. For installation of conduits for Rocky Mountain Power (RMP) feeders provide Schedule 40 PVC with long radius sweep fiberglass elbows. Coordination RMP standards for trench width, depth and spacing from other utilities. Provide back fill material of sand, screened backfill, etc., acceptable to RMP or as specified elsewhere in these specifications, whichever is more stringent.

B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.

C. Install raceway in accordance with the following:

1. Provide a minimum of 12" clearance measured from outside of insulation from flues, steam and hot water piping, etc. Avoid installing raceways in immediate vicinity of boilers and similar heat emitting equipment. Conceal raceways in finished walls, ceilings and floor (other than slab-on-grade), except in mechanical, electrical and/or communication rooms, conceal all conduit and connections to motors, equipment, and surface mounted cabinets unless exposed work is indicated on the drawings. Run concealed conduits in as direct a line as possible with gradual bends. Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines. Do not install lighting raceway until piping and duct work locations have been determined in order to avoid fixtures being obstructed by overhead equipment.
2. PVC conduit not allowed within CMU and block type walls.
3. The required raceway size, for any given installation, shall remain the same throughout the entire length of the run. At no point shall any conduit be reduced in size.
4. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway. Paint all field threads (or portions of raceway where corrosion protection has been damaged) with primer and enamel finish coat to match adjacent raceway surface.
5. Provide a minimum of 1 ½” from nearest surface of the roof decking to raceway.
6. In open gymnasiums, auditoriums, etc; all conduit shall be installed in straight lines parallel to, or at right angles to, the structure or adjacent building elements. Separations between conduits and fastenings of conduits shall be neat and consistent. Conduit shall be installed as tight to the bottom of structural elements when parallel to joists as code will allow. Overall installation shall be accomplished in an aesthetic and workmanlike manner. No conduits shall be allowed to run perpendicular to the bottom chord and at the bottom of the joists.
7. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling. No exposed cables shall be seen from below.
8. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
9. Provide neutral and ground wire as specified elsewhere in documents.
10. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

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D. Comply with NEC for requirements for installation of pull boxes in long runs.

E. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandrel and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.

F. Replace all crushed, wrinkled or deformed raceway before installing conductors.

G. Do not use flame type devices as a heat application to bend PVC conduit. Use a heating device that supplies uniform heat over the entire area without scorching the conduit.

H. Provide rigid metal conduit (RMC) for all bends greater than 22 degrees in buried conduit. Provide protective coating for RMC bend as specified herein.

I. Where raceways penetrate building, area ways, manholes or vault walls and floors below grade, install rigid metal conduit (RMC) for a minimum distance of 10 feet on the exterior side of the floor or wall measured from interior face. Provide OZ, Type FSK, WSK or CSMI sealing bushings (with external membrane clamps as applicable) for all conduit penetrations entering walls or slabs below grade. Provide segmented type CSB internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway.

J. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.

K. Install spare 3/4" conduits (capped) from each branch panelboard into the ceiling and floor space. Run five into the ceiling space and five into the floor space. Where the floor is not accessible run six conduits into the ceiling space. Run conduits the required distance necessary to reach accessible ceiling space.

L. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.

M. Provide OZ cable supports in all vertical risers in accordance with NEC 300-19; type as required by application.

N. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.

O. Raceway installation below grade:

1. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
2. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
3. Utility burial depths must comply with RMP requirements or AHJ, but in no case be less than 48" minimum, unless noted otherwise on drawings, diagrams etc.

P. Raceway installation below slab-on-grade, or below grade:

1. For slab-on-grade construction, install runs of rigid plastic conduit (PVC) below slab. All raceway shall be located a at top of sub-grade and a minimum of 6” below bottom of slab. Stake down conduits as required to keep conduits from floating or moving. Coordinate strictly with other trades at grade level structural members for correct installation. Install RMC (with protective coating) for raceways passing vertically through slab-on-grade. Slope raceways as required to drain away from electrical enclosures and to avoid collection of moisture in raceway low points.

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2. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
3. Mark all buried conduits that do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
4. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
5. Do not locate utility feeds under any structure. Verify all utility power paths with RMP prior to any rough-in. Utility burial depths must comply with RMP requirements or AHJ, but in no case be less than 48" minimum, unless noted otherwise on drawings, diagrams etc.

Q. Raceway installation in suspended slabs:

1. No conduit can be installed in suspended slabs.

R. Raceway installation in hazardous locations:

1. Install RMC in all hazardous locations as defined by NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with requirements.
2. Engage at least five full threads on all fittings. Provide inspection fittings with explosion proof drains to prevent water accumulation in conduit runs. Install seal-offs for arcing or high temperature equipment, at housing with splices or taps and where conduits enter or leave the hazardous area. Provide seal-offs of the appropriate type for vertical or horizontal installation. Ground all metallic parts.

S. DUCTBANKS:

1. Provide ductbank construction as indicated using 3000 psi at 28 day strength concrete. Use Type II low alkali per ASTM C150. Use ASTM C-33 aggregate gradation with maximum size of 3/4". Use W/C ratio of 0.50. Install #4 reinforcing bar per ASTM 615 grade 50 in each corner of ductbank. Provide minimum 4" concrete cover on all sides of exterior conduits. Provide polypropylene pull rope in all spare duct.

T. Electrical Identification: Refer to Section 260553 for requirements.

END OF SECTION 26 0532

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SECTION 26 0533

ELECTRICAL BOXES AND FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to electrical wiring boxes and fittings specified herein. See Section 260532, Raceways, for additional requirements.

1.2 DESCRIPTION OF WORK:

A. The extent of electrical box and electrical fitting work is indicated by drawings and schedules.

B. Types of electrical boxes and fittings in this section include the following:

1. Outlet Boxes
2. Junction Boxes
3. Pull Boxes
4. Floor Boxes
5. Conduit Bodies
6. Bushings
7. Locknuts
8. Knockout Closures
9. Miscellaneous Boxes and Fittings

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134,1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings that have been UL-listed and labeled.

1.4 SUBMITTALS:

A. Submit manufacturer’s data including specifications, installation instruction and general recommendations for each type of floor box used on project.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

A. INTERIOR OUTLET BOXES:

1. Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes with accessory rings, of types, shapes and sizes, including box depths, to suit each respective location and installation, construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices; minimum size 4"x4"x2-1/8".

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2. Provide an 'FS' box, with no knockouts when surface mounted in a finished, non-utility space. Surface mounting is only acceptable when approved by the Architect.

B. INTERIOR OUTLET BOX ACCESSORIES:

1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, that are compatible with outlet boxes being used and fulfilling requirements of individual wiring applications.

C. WEATHERPROOF OUTLET BOXES:

1. Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes (including depth) required, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, with face plate gaskets and corrosion-resistant fasteners.

D. JUNCTION AND PULL BOXES:

1. Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

E. FLOOR BOXES:

1. Single Service Floor Box: Provide leveling and fully adjustable floor service receptacle outlets and fittings of types and ratings indicated; and with finish as selected by Architect. Equip with wiring devices as specified in Section 262726. Provide boxes compatible with floor system; provide epoxy-coated stamped steel boxes or cast iron boxes for slab-on-grade construction; provide stamped steel boxes for suspended slabs. Equip with tile and/or carpet flanges to accommodate floor finish material. Boxes shall be available in one, two or three gang configurations. Boxes shall comply with UL Standard UL514A.

2. Multi-Service Floor Box: Provide leveling and fully adjustable multi compartment floor box; there shall be multiple independent wiring compartments; the floor box shall permit tunneling from end power compartment to end power compartment. Floor box shall accommodate a minimum of two duplex receptacles and two mounting plates for telecommunication devices. Equip with wiring devices as specified in Section 262726. Provide boxes compatible with floor system; with finish as selected by Architect. Provide epoxy-coated stamped steel boxes or cast-iron boxes for slab-on-grade construction; provide stamped steel boxes for suspended slabs. Equip with tile and/or carpet flanges to accommodate floor finish material. Boxes shall comply with UL Standards UL514A and/or UL514C.

3. Manufacturer: subject to compliance with requirements, provide floor boxes as indicated on the drawings.

   a. Harvey Hubbell, Inc.

   b. Wiremold

F. CONDUIT BODIES:

1. Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

G. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS:

1. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable steel conduit bushings and offset connectors, of types and sizes to suit respective uses and installation.

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PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

A. GENERAL:

1. Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
3. Provide coverplates for all boxes. See Section 262726, Wiring Devices.
4. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
5. Provide knockout closures to cap unused knockout holes where blanks have been removed.
6. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Do not install boxes above ducts or behind equipment. Install recessed boxes with face of box or ring flush with adjacent surface. Seal between switch, receptacle and other outlet box openings and adjacent surfaces with plaster, grout, or similar suitable material.
7. Fasten boxes rigidly to substrates or structural surfaces, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them. Set boxes on opposite sides of fire resistant walls with minimum of 24” separation.
8. Provide a minimum of 1 ½” from the nearest surface of the roof decking to the installed boxes.
9. Provide electrical connections for installed boxes.

END OF SECTION 26 0533

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SECTION 26 0536

RACEWAY SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 Section making reference to electrical raceways specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of raceways is indicated by drawings and schedules.

B. Types of raceways in this section include the following:

1. Surface metal raceways
2. Wire basket cable tray systems.

1.3 QUALITY ASSURANCE:

A. STANDARDS:

1. Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.
2. Comply with the following publications and standards for construction and installation or wire basket cable tray:
   a. Comply with NEC Article 392
   b. NEMA VE-1; NEMA VE-2-2001
   c. NFPA 70B
   d. ASTM B633; ASTM A653; ASTM A510

1.4 SUBMITTALS:

A. Refer to section 26 0502 submittal requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURED RACEWAY SYSTEMS:

A. GENERAL:

1. Provide electrical raceways of types, grades, sizes, weights [wall thicknesses], and number of channels, for each service indicated. Provide complete assembly of raceway including, but not necessarily limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps, and other components and accessories as needed for complete system.

B. SURFACE METAL RACEWAYS:

1. Provide galvanized steel surface metal raceways of sizes and channels indicated. Provide fittings indicated that match and mate with raceway. Paint with

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manufacturer's standard prime coating and finish color as indicated. Provide receptacles on centers as indicated on drawings or as directed by engineer.

2. MANUFACTURER:
   a. Subject to compliance with requirements, provide surface metal raceways of one of the following:
      i. Wiremold Company AL3300

C. WIRE BASKET CABLE TRAY SYSTEMS:

1. Refer to specification 27 1010 for information relating to the school districts standards for cable tray installation.
2. MANUFACTURER:
   a. Subject to compliance with requirements, provide cable tray system of one of the following (OR APPROVED EQUAL):
      i. Cooper B-Line WB400 Series Systems
3. Provide wire basket cable tray of types, grades, ratings, and sizes as specified and indicated meeting all requirements of NEMA VE-1. Provide complete assembly of raceway including, but not necessarily limited to, offsets, adapters, connector plates, splice plates, brackets, connector assemblies, holddown clamp assemblies, grounding clamps and other components and accessories as needed for complete system.
4. WIRE BASKET: Wire basket shall be made of high strength steel wires conforming to ASTM A510, and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All wire ends along wire basket sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
   a. All straight section longitudinal wires shall be straight, with no bends.
   b. Straight sections shall be furnished in standard 118 inch lengths.
   c. Wire basket shall have a 4 inch usable loading depth by 20 inches wide.
   d. Wire basket shall be electro-plated zinc in accordance with ASTM B633 SC2, with clear chromate sealer.
   e. Wire basket shall have a load capacity of 116 lbs per foot based on 5 foot spacing between supports.
5. BENDS: Horizontal and vertical bends, and horizontal tees shall be field formed. Inside radius of field bends shall be no less than 12 inches, and in no case smaller than required to comply with minimum radius requirement of cable manufacturer. Horizontal bends and tees shall be made such that the side rail of the tray is continuous with no gaps.
6. SPLICE ASSEMBLIES: Splice assemblies shall consist of splice plates and clamp/connectors furnished by the tray system manufacturer as standard components of the system. Splice assemblies shall be used to join separate horizontal sections together. Splice plates shall be approximately 2.7 inches long by 1.6 inches high, zinc-plated. Clamp/connectors shall be the bolted type consisting of welded stud plates with threaded studs and serrated flanged locknuts. Hardware shall be zinc-plated.
7. ACCESSORES AND COMPONENTS: Support accessories shall be zinc-plated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.
8. Provide all fittings including connector plates, splice plates, clamps, supports, etc.
9. Grind all rough edges, drip concentrations, etc., to smooth finish. Apply cold zinc spray to all field cut surfaces.

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PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.

B. Provide a minimum of (4) 4” trade size Hilti Speedsleeves (or STI EZPath) with at least one spare for each and every firewall penetration where cable tray meets the wall.

C. Provide a minimum of (4) 4” trade size conduits within cable where inaccessible ceilings that span more than 12’.

D. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.

E. Seal joints of underfloor ducts with sealing compound or tape prior to placing concrete.

F. Level and square raceway runs, and install at proper elevations/heights.

3.2 ADJUSTING AND CLEANING:

A. Upon completion of installation of raceways, inspect interiors of raceways; remove burrs, dirt and construction debris.

END OF SECTION 26 0536

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SECTION 26 0548

ELECTRICAL SEISMIC CONTROL

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Anchorage and seismic restraint systems for all Division 26 isolated and non-isolated equipment, cable tray, and conduit systems.

B. Equipment/cable tray/conduit to isolated and/or seismically supported shall include but not be limited to the following:

1. Pad Mounted Equipment
2. Conduit
3. Cable Tray
4. Light Fixtures

1.2 RELATED WORK:

A. Requirements: Provide Electrical Seismic Control in accordance with the Contract Documents.

B. Section 26 0500 – Electrical General Provisions

1.3 REFERENCES:

A. International Building Code, Current Edition in use by Jurisdictional Authority.

B. NFPA Bulletin 90A, Current Edition.

C. UL Standard 181.

1.4 SYSTEM DESCRIPTION

A. The Division 26 Contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with the following:

1. Short period design spectral response acceleration coefficient SDS=0.70.
2. One second period design spectral response acceleration coefficient SD1=0.28.
3. Site Class B.
4. Seismic Design Category D.
5. Importance Factor (Ip) = 1.0 1.5

B. Seismic Restraint Exceptions

1. The following components are exempt from the requirements of this section

1.5 QUALITY ASSURANCE:

A. All supports, hangers, bases, anchorage and bracing for all isolated equipment and non-isolated equipment shall be designed by a professional engineer licensed in the state where the project is located, employed by the restraint manufacturer, qualified with seismic experience in bracing for electrical equipment. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal. All calculations/design work required for the seismic anchorage and restraint of all Division 26 equipment and systems shall be provided by a single firm.

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B. The above qualified seismic engineer shall determine specific requirements for equipment anchorage and restraints, locations and sizes based on shop drawings for the electrical equipment that have been submitted, reviewed and accepted by the Architect/Engineer for this project.

C. Seismic Engineer or the Engineer's Representative shall field inspect final installation and certify that bracing and anchorage are in conformance with the Seismic Engineer's design. A certificate of compliance bearing the Seismic Engineer's signed Professional Engineer's seal shall be submitted and shall be included in each copy of the Operation and Maintenance Manuals.

D. The Division 26 Contractor shall require all equipment suppliers furnish equipment that meets the seismic code, with bases/skids/curb designed to receive seismic bracing and/or anchorage. All isolated and non-isolated electrical equipment bracing to be used in the project shall be designed from the Equipment Shop Drawings and certified correct by the equipment manufacturer for seismic description listed in Paragraph 1.4 above, with direct anchorage capability.

1.6 SUBMITTALS:

1. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 – PRODUCTS:

2.1 RESTRAINT EQUIPMENT AND SYSTEMS:

A. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:

1. Mason Industries, Inc.
2. Korfund
3. Amber/Booth Company
4. Vibration Mountings and Control Company
5. Kinetics
6. International Seismic Application Technology
7. Tolco

B. Manufacture and design of restraints and anchors for isolated equipment shall be by the manufacturer of the vibration isolators furnished for the equipment.

2.2 SNUBBERS:

A. Snubbers shall be all-directional and consist of interlocking steel members restrained by replaceable shock absorbent elastomeric materials a minimum of 3/4 inch thick.

B. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch.

C. Snubbers shall be Mason Industries Z -1011 or accepted equivalent.

PART 3 – EXECUTION

3.1 DESIGN AND INSTALLATION:

A. General:

1. All electrical components shall be braced, anchored, snubbed or supported to withstand seismic disturbances in accordance with the criteria of this specification. Provide all engineering, labor, materials, and equipment for protection against seismic disturbances as specified herein. The following electrical components are exempt from seismic restraint requirements.

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a. Electrical components in Seismic Design Category A or B (see section 1.4)

b. Electrical components in Seismic Design Category C provided that the component importance factor, I_p, is equal to 1.0 (see section 1.4).

c. Electrical components in Seismic Design Categories D, E, or F where all of the following apply:

i. The component importance factor, I_p, is equal to 1.0;

ii. The component is positively attached to the structure;

iii. Flexible connections are provided between the component and associated ductwork, piping, and conduit; and either

1. The component weighs 400 lb (1,780 N) or less and has a center of mass located 4 ft (1.22 m) or less above the adjacent floor level; or

2. The component weighs 20 lb (89 N) or less or, in the case of a distributed system, 5 lb/ft (73 N/m) or less.

2. Powder-actuated fasteners (shot pins) shall not be used for component anchorage in tension applications in Seismic Design Category D, E, or F.

3. Attachments and supports for electrical equipment shall meet the following provisions:

a. Attachments and supports transferring seismic loads shall be constructed of materials suitable for the application and designed and constructed in accordance with a nationally recognized structural code such as, when constructed of steel, AISC, Manual of Steel Construction (Ref. 9.8-1 or 9.8-2).

b. Friction clips shall not be used for anchorage attachment.

c. Expansion anchors shall not be used for electrical equipment rated over 10 hp (7.45 kW). Exception: Undercut expansion anchors.

d. Drilled and grouted-in-place anchors for tensile load applications shall use either expansive cement or expansive epoxy grout.

e. Supports shall be specifically evaluated if weak-axis bending of light-gauge support steel is relied on for the seismic load path.

f. Components mounted on vibration isolation systems shall have a bumper restraint or snubber in each horizontal direction. The design force shall be taken as 2Fp. The intent is to prevent excessive movement and to avoid fracture of support springs and any non- ductile components of the isolators.

g. Seismic supports shall be constructed so that support engagement is maintained.

B. Pad Mounted Equipment

1. Spring Isolated Equipment:

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a. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.

2. Non-Isolated Equipment:

a. The section 260548 (Electrical Seismic Control) Contractor shall be responsible for thoroughly reviewing all drawings and specifications to determine all equipment i.e. switchboards, transformers, generators, etc. to be restrained. This Contractor shall be responsible for certifying that this equipment is mounted and braced such that it adheres to the system description criteria in part 1.4 of this specification section.

C. Conduit, Conduit Racks/Trapeze Assemblies, Cable Tray and Bus Duct:

1. Seismic braces for be omitted when the distance from the supporting structure to the raceway support point is 12” or less. Where rod hangers are used, they shall be equipped with swivels to prevent inelastic bending in the rod.
2. Seismic braces may be omitted where the total weight of the assembly is less than 10 lb/ft.
3. Seismic braces for individual conduit may be omitted for conduit less than 2.5 inch trade size.
4. A rigid conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
5. Unbraced conduit attached to in-line equipment shall be provided with adequate flexibility to accommodate differential displacements.
6. At the interface of adjacent structures or portions of the same structure that may move independently, utility lines shall be provided with adequate flexibility to accommodate the anticipated differential movement between the ground and the structure.
7. Provide large enough pipe sleeves through wall or floors to allow for anticipated differential movements.
8. For spaces, where the Importance Factor (Ip) is equal to 1.5, all electrical components that are attached to structures that could displace relative to one another and for isolated structures where components cross the isolation interface, the components shall be designed to accommodate the eismic relative dispalcements.

D. Light Fixtures

1. Light fixtures, lighted signs, and ceiling fans not connected to ducts or piping, which are supported by chains or otherwise suspended from the structure, are not required to satisfy the seismic force and relative displacement requirements provided they meet all of the following criteria:
   a. The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be applied in the direction that results in the most critical loading for the design.
   b. Seismic interaction effects shall not cause an effect so that the failure of the non-essential component causes a failure of an essential component.

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c. The connection to the structure shall allow a 360° range of motion in the horizontal plane.

d. The component is less than 20 lbs and has flexible connections and an importance factor (Ip) equal to 0.

END OF SECTION 26 0548

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SECTION 26 0553

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Requirements of the following Division 26 Sections apply to this section:

1. “Basic Electrical Requirements”.
2. “Basic Electrical Materials and Methods”.

1.2 SUMMARY

A. This section includes identification of electrical materials, equipment and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labels for raceways, cables and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.
6. Arc-flash hazard labels

B. Related Sections: The following sections contain requirements that relate to this section:

C. Division 9 Section “Painting” for related identification requirements.

D. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.3 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code”

1.4 SUBMITTALS:

1. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. American Labelmark Co.
2. Calpico, Inc.
3. Cole-Flex Corp.
4. Emed Co., Inc.
5. George-Ingraham Corp.
6. Ideal Industries, Inc.

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7. Kraftbilt
8. LEM Products, Inc.
9. Markal Corp
10. National Band and Tag Co.
11. Panduit Corp.
12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W.H Brady, Co.

2.2 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Conduit Systems for raceway identification:

1. Factory-painted conduit and/or factory-painted couplings and fittings

B. Colored paint for raceway identification:

1. Use Kwal Paint colors as specified in Part 3 – Execution.

C. Color Adhesive Marking Tape for Raceways, Wires and Cables:

1. Self-adhesive vinyl tape not less than 3 mills thick by 1” to 2” in width.

D. Underground Line Detectable Marking Tape:

1. Permanent, bright colored, continuous-printed, acid- and alkali-resistant plastic tape specifically compounded for direct-burial service. Not less than 6” wide by 4 mills thick.
2. With metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
3. Printed legend indicative of general type of underground line below.

E. Wire/Cable Designation Tape Markers:

1. Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letters.

F. Brass or Aluminum Tags:

1. Metal tags with stamped legend, punched for fastener.
2. Dimensions: 2” X 2” 19 gage.

G. Engraved, Plastic Laminated Labels, Signs and Instruction Plates:

1. Engraving stock plastic laminate, 1/16” minimum thickness for signs up to 20 sq. in. or 8” in length; 1/8 “ thick for larger sizes. Engraved legend in 1/4” high white letters on black face and punched for mechanical fasteners.

H. Arc-flash Hazard Labels:

1. ANSI Z535.4 Safety Label.
2. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
3. Dimensions: 5” x 3.5”
4. Information contained: Arc-flash boundary; Voltage; Flash Hazard Category; Incident Energy (arc rating); checkboxes for the required Personal Protective Equipment (PPE) and the date that the calculations were performed.

I. Equipment Labels:

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1. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
2. Dimensions: minimum 5” x 2”
3. Conductor-Identification-Means Labels:
    a. Information contained: the method utilized for identifying ungrounded conductors within switchboards, distribution panels and branch circuit panels.
4. Available-Fault-Current Labels:
    a. Information contained: maximum available fault current at the respective piece of equipment, and date of calculation of fault current.
5. Source-of-Supply Labels:
    a. Information contained: indicate the device or equipment where the power supply originates.

J. Baked Enamel Warning and Caution Signs for Interior Use:

1. Preprinted aluminum signs, punched for fasteners, with colors legend and size appropriate to location.

K. Fasteners for Plastic-Laminated and Metal Signs:

1. Self-tapping stainless steel screws or # 10/32 stainless steel machine screws with nuts, flat and lock washers.

L. Cable Ties:

1. Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18” minimum width, 50-lb. Minimum tensile strength, and suitable for a temperature range from minus 40° F. to 185° F. Provide ties for specified colors when used for color coding.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics:

1. Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer’s written instructions and requirements of NEC.

C. Sequence of Work:

1. Where identification is to be applied to surfaces that require a finish, install identification after completion of finish work.

D. Conduit Identification:

1. Identify Raceways of Certain Systems with Color Coding. Acceptable means of color identification are as follows:
    a. Colored adhesive marking tape.
    b. Field-painted colored bands.
    c. Factory-painted conduit.
        i. Provide Red Factory-painted conduit for Fire Alarm.
    d. Color exposed or accessible raceways of the following systems for identification. Make each color band 2 inches wide, completely encircling

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conduit. Apply bands at changes in direction, at penetrations of walls and floors, and at 20-foot maximum intervals in straight runs. Apply the following colors:

i. Fire Alarm System: Red

ii. AV: White

iii. Intercom: Yellow

iv. Telephone/Data: Blue

v. Security: Grey

vi. Elevator Phone: Orange

vii. Legally Required Emergency Systems: Orange (Per NEC 700.10(A))

2. Identify Junction, Pull and Connection Boxes.

   a. Code-required caution sign for boxes shall be pressured-sensitive, self-adhesive label indication system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers on outside of cover with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

3. Label and paint the covers of the systems junction boxes as follows:

SYSTEM	COLOR (ALL COLORS ARE KWAL PAINT)	
Fire Alarm	Red Alert	AC118R
AV	White	
Intercom	Yellow	
Data	Neon Blue	7076A
WAPs	Purple	
Cameras	Orange	
Security	Grey	

E. Underground Electrical Line Identification.

1. During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground line detectable marking tape, located directly above line at 6 to 8 inches below finished grade. Where multiple lines are installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.

2. Install detectable marking tape for all underground wiring, both direct-buried and in raceway.

3. Provide red marker dye applied to concrete encased ductbank.

F. Conductor Color Coding.

1. Provide color coding for secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

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120/208 Volts	Phase	277/480 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

2. Switch legs, travelers and other wiring for branch circuits shall be of colors other than those listed above.
3. Use conductors with color factory applied the entire length of the conductors except as follows:
   a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
   b. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
   c. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

G. Power Circuit Identification.

1. Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb monofilament line or one-piece self-locking nylon cable ties.
2. Tag or label conductors as follows:
   a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicting source and circuit numbers.
   b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/ signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

H. Apply warning, caution and instruction signs and stencils as follows:

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1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items. Warning and caution signs shall be furnished and installed on, but not be limited to the following equipment and locations:
    a. Entrances to rooms and other guarded locations that contain exposed live parts 600 volts or less; signs shall forbid unqualified personnel to enter.
    b. Switch and Overcurrent device enclosures with splices, taps and feed-through conductors. Provide warning label on the enclosures that identifies the nearest disconnecting means for any feed-through conductors.
    c. Entrances to buildings, vaults, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts: DANGER-HIGH VOLTAGE-KEEP OUT.
    d. Metal-enclosed switchgear, unit substations, transformers, enclosures, pull boxes, connection boxes and similar equipment operating at over 600 volts shall have appropriate caution signs and warning labels.
    e. Indoor and Outdoor substations operating over 600 volts. Provide warning signs, instructional signs and single-line diagrams in accordance with NEC 225.70.

I. Emergency Operating Signs: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

J. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/4“-high lettering on 1-inch-high label (1 1/2-inch-high where two lines are required) white lettering in black field. White lettering in red field for Emergency Power Systems. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
    a. Each service disconnect, to identify it as a service disconnect.
    b. Panelboards (exterior and interior), electrical cabinets, and enclosures. For subpanels, identify feeder circuit served from.
    c. Switches in fusible panelboards shall be labeled. Main switches shall be identified.
    d. Access doors and panels for concealed electrical items.
    e. Electrical switchgear and switchboards.
    f. Motor control centers.
    g. Motor starters, including circuit origination, HP, heater size, FLA, and mechanical equipment designation.
    h. Disconnect switches.
    i. Pushbutton stations.
    j. Power transfer equipment.

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k. Contactors.
l. Dimmers.
m. Control devices.
n. Transformers.
o. Power generating units, to include transfer switches.
p. Telephone switching equipment.
q. Clock/program master equipment.
r. Call system master station.
s. TV/AV equipment.
t. Fire alarm master station or control panel.
u. Variable frequency drives.
v. Lighting Control Equipment.
w. Uninterruptable Power Supply.

K. Post Conductor-Identification-Means labels at locations of switchboards, distribution panels and branch circuit panels. The labels shall identify the color-coding used on ungrounded conductors for each voltage system used on the premises.

L. Apply Available-Fault-Current labels at the service entrance equipment.

M. Apply Source-of-Supply labels on the exterior covers of equipment (except in single- or two-family dwellings) as follows:

1. Each switchboard supplied by a feeder.
2. Each branch circuit panelboard supplied by a feeder.
3. Each disconnect switch serving elevators, escalators, moving walks, chairlifts, platform lifts and dumbwaiters.
4. Each dry type transformer (or primary-side disconnect switch at transformer). If the primary-side disconnect is remote from the transformer, both the remote disconnect and the transformer shall be labeled, and the transformer label shall also indicate the location of the disconnect.
5. Each feeder disconnect, branch circuit disconnect, panelboard or switchboard in a remote building or structure.
6. Each on-site emergency power source, with sign placed at service entrance equipment to comply with NEC 700.

N. The label shall identify the device or equipment where the power supply originates, and the system voltage, phase or line and system at all termination, connection and splice points. For example: Feeder Power Supply for Panel “XX” Originates at Panel “XX” (or Switchboard “XX”, Transformer “XX”, Switch “XX”, etc.); 120/208 volts, 3-phase, Phase Color Identification (or 120/240, 277/480, etc.).

O. Install Arc-flash hazard labels on the following equipment:

1. Each piece of service entrance equipment.
2. Each power distribution switchboard or panel.
3. Each individually mounted circuit breaker.
4. Each branch circuit panelboard.
5. Each motor control center.
6. Each individually mounted motor starter.
7. Each meter socket enclosure.

P. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect

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switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.

Q. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

R. Engrave all receptacle plates other than those serving 120 volt, single phase devices. State voltage and amperage characteristics: Example; “208V 30A”.

S. Mark each device box (for each type of wiring device) with a permanent ink felt tip marker, indicating the circuit that the device is connected to: Example; “CKT A-1”

T. Label circuit breaker feeding fire alarm panel “Fire Alarm Circuit”. Using plastic laminate label, white lettering on a red background.

END OF SECTION 26 0553

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SECTION 26 0573

PROTECTIVE DEVICE STUDY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Studies in this section include the following:

1. Fault current protective device and equipment evaluation
2. Protective device coordination study
3. Arc-flash hazard analysis and study

1.3 QUALITY ASSURANCE:

A. Provide protective device and arc-flash hazard studies performed by qualified engineers of the equipment manufacturer or an approved consultant. Studies must bear the professional engineer's stamp of the engineer in responsible charge of the protective device studies. Perform all work in accordance with latest IEEE and ANSI standards.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – STUDIES

2.1 FAULT CURRENT PROTECTIVE DEVICE & EQUIPMENT EVALUATION

A. Perform fault current analysis with the aid of a computer and appropriate software. Include as input data the maximum available short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.

B. Coordination Criteria:

1. All overcurrent protective devices serving the essential electrical system shall be coordinated for the period of time that a fault's duration extends beyond 0.1 second. Provide overcurrent protection devices with larger frames sizes to ensure coordination has been achieved.

2. Coordination shall not be required as follows:

a. Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exist on the transformer secondary.

b. Between overcurrent protective devices of the same size (ampere rating) in series.

C. Calculate fault current close and latch duty values and interrupting duty values on the basis of assumed three-phase bolted short circuits at each switchgear bus, medium

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voltage controller, switchboard, low voltage motor control center, distribution panelboard, branch circuit panel and other significant locations throughout the system. Include symmetrical fault currents, and X/R ratios in the fault current tabulations. For each fault location, list the total duty on the bus, as well as the individual contribution from each connected branch, with its respective X/R ratio. Calculate ground fault currents at each bus. Incorporate major motor contributions in determining momentary and interrupting ratings of protection devices.

D. Perform an evaluation to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses, by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Apply appropriate multiplying factors based on system X/R ratios and protective device rating standards. Report problem areas or inadequacies in the equipment due to short circuit currents prior to release for fabrication of switchgear, switchboards and/or appliance panelboard.

2.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Perform a protective device coordination study including the necessary calculations and logic decisions required to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. Perform the studies in accordance with the latest applicable IEEE and ANSI standards.

B. Include all medium and low voltage classes of equipment in the coordination study from the building or plant service protective devices down to and including the largest rated device in the low voltage motor control centers and panelboards. Include the phase and ground overcurrent protection as well as settings of all other adjustable protective devices.

C. Develop time-current characteristics of the specified protective devices on log-log paper. Include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. Indicate on plots the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. Adhere to all restrictions of the National Electrical Code. Maintain proper coordination intervals and separation of characteristic curves.

D. Provide coordination plots for phase and ground protective devices on a system basis. Provide a sufficient number of separate curves to clearly indicate the coordination achieved.

E. Provide the selection and settings of the protective devices in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. Provide a tabulation of the recommended power fuse selection for medium voltage fuses where applied in the system. Promptly report any discrepancies, problem areas, or inadequacies prior to release for fabrication of switchgear, switchboards and/or appliance panels.

2.3 ARC-FLASH HAZARD ANALYSIS AND STUDY

A. Perform an arc-flash hazard analysis and study. Include the necessary calculations required to determine the level of Personal Protection Equipment (PPE) that a worker must use, the Arc Flash Boundary in inches, and the incident energy at each location. This information shall be calculated and determined for each piece of service entrance equipment, each power distribution switchboard or panel, each separately-mounted circuit breaker, each motor control center, each individually mounted motor starter, and for each branch circuit panelboard.

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B. Perform the analysis and study in accordance with IEEE 1584.

C. Furnish and install a label at each piece of service equipment, each power distribution switchboard or panel, each separately mounted circuit breaker, each motor control center, each individually mounted motor starter, and each branch circuit panel board. The label shall be an ANSI approved Arc Flash Warning Label that warns and instructs workers of the arc flash hazard, voltage, arc flash boundary, and required PPE (Personal Protective Equipment).

2.4 ANALYSIS/REPORT

A. Include the following in the report.

1. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system that is included within the scope of the study.
2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties and commentary regarding same. Include formulas and description of methods used.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.
5. Recommended size for power fuses and recommended settings for ground fault relays and for all adjustable trip relays, circuit breakers, etc.
6. Tabulation of arc-flash calculations for each location and tabulation of arc-flash hazard, voltage, boundary and required PPE for each equipment item listed in the arc-flash analysis.

2.5 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

A. Provide adjustments to circuit breakers and switchboard AIC ratings as deemed necessary by the analysis/report, with no additional cost to the Owner. Provide over current protection devices with larger frame sizes to ensure coordination has been achieved.

B. Provide the services of a qualified field engineer employed by the equipment manufacturer, and necessary tools and equipment to test, calibrate and adjust the protective relays, ground fault relays and circuit breaker trip devices as recommended in the Protective Device Study.

2.6 TYPEWRITTEN DEVICE SETTING TABULATION:

A. Provide type written tabulation that includes all settings for each protective relay, ground fault relay and circuit breaker solid-state trip devices. Enclose the table in a protective plastic sleeve and affix to the main service entrance equipment.

END OF SECTION 26 0573

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SECTION 26 0923

OCCUPANCY SENSORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of occupancy sensor work is indicated by drawings and schedules.

B. Types of occupancy sensors in this section include the following:

1. Dual Technology Wall Switch
2. Dual Technology Wall Switch with Dimming and Daylight Control.
3. Dual Technology Ceiling Sensor w/ Control Pack

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of occupancy sensors. Provide occupancy sensors that have been UL listed and labeled.

B. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, motor loads and any other passive infrared or microwave systems.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURER: The manufacturer shall have a minimum of five years of experience in the sensor and lighting control industry. Sensors and related relays shall be compatible with the specific lighting types controlled. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable.

A. DUAL TECHNOLOGY WALL SWITCH: Where units are indicated provide a sensor that meets the following minimum requirements:

1. Sensor shall utilize PIR (Passive Infrared) to turn on the lights and then PIR or US (Ultrasonic) technologies to keep lights on.
2. Sensor shall incorporate an inrush current limiter circuit to protect the relay contacts.
3. Sensor shall utilize single or dual dry relay contacts for control of the lighting loads. Contractor shall verify requirements in coordination with the drawings.
4. Sensor shall have a self-adjusting time delay, selectable 5, 15 and 30 minutes.
5. Sensor shall have automatic sensitivity adjustment and be microprocessor controlled.
6. Sensor shall have light level sensing 0 to 200 footcandles.

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7. Sensor shall have a 180 degree field of view, coverage up to 800 square feet and shall detect 6 inches of hand movement towards the sensor up to 300 square feet; and body motion towards the sensor up to 1000 square feet.
8. Sensor shall be rated for 0 to 800 watts at 120VAC and 0 to 1200 watts at 277VAC.
9. Sensor shall be automatic on and shall have an automatic to off override switch on the unit. Switch shall be equipped with an air gap switch to disconnect power to the lighting load.
10. Sensor shall have real time motion indicator on the front of the unit.
11. Sensor shall mount to a single gang switch box.
12. Subject to compliance with the above requirements. Provide models of one of the following:
    a. Wattstopper

B. DUAL TECHNOLOGY WALL SWITCH WITH DIMMING AND DAY-LIGHT CONTROL: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Dual technology sensors shall have one of its two technologies, not require motion to detect occupancy.
2. Sensors shall offer a minimum on timer of at least 15 minutes, in order to prevent all cycling of lamps before they have burned for the lamp manufacturers minimum recommended time period.
3. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 15 minutes.
4. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated.
5. Sensor shall be capable of switching both 120 VAC and 277 VAC.
6. Sensor shall recess into single gang switch box and fit standard GFI opening.
7. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.
8. Line and load wire connections shall be interchangeable.
9. Wall switch sensor shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point.
10. Sensor shall be capable of both auto-on and manual operation.
11. Combination photocell/dimming sensors set point and deadband shall be automatically calibrated through the sensors microprocessor by initiating the automatic set point programming procedure. Min and max dim settings as well as set point may be manually entered.
12. Subject to compliance with the above requirements, provide models of one of the following:

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a. Wattstopper – DW-311 (No Daylight Dimming, use when daylighting is not required)

C. DUAL TECHNOLOGY CEILING SENSOR: Where units are indicated, provide a sensor that meets the following minimum requirements:

1. Sensor shall incorporate ultrasonic (microphonics) and infrared technologies in a single unit.
2. Sensor shall be Class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
3. Sensor shall use internal microprocessor for motion signal analysis and automatic self-adjustment.
4. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
5. Sensor shall have manual time-out adjustment from 8 minutes to 32 minutes and automatic time out from 8 minutes to 100 minutes.
6. Sensor shall have test time-out setting of 8 seconds, with automatic return to 8 minutes after one hour if sensor is left in test mode.
7. Sensor's microprocessor shall automatically extend timer by 1 hour in response to recognition to false off condition. After 5 hours, sensor reduces extended time by 30 minutes and continues to reduce by 30 minute increments over the next few days.
8. Sensor's microprocessor shall automatically reduce either PIR or ultrasonic sensitivity in response to false on condition.
9. Sensor microprocessor will automatically monitor PIR background threshold signal level and makes corresponding sensitivity adjustments automatically.
10. Sensor microprocessor algorithm shall incorporate automatic adaptation to continuous airflow.
11. For airflow that is so intense as to mask motion, sensor shall flash indicator LED code to indicate excessive airflow.
12. Sensor's microprocessor shall use a four week learning period and develop a circadian calendar.
13. An internal 24 hour 7 day clock establishes what periods the room is typically occupied, biasing sensor to keep lights on while normally occupied and off when normally unoccupied.
14. Sensor shall have selection settings for the following dual technology schemes:
    a. High Sensitivity and High Confidence (miser mode)
15. Sensor shall be available with either 180 degrees or 360 degrees coverage pattern.
16. Infrared lens shall have 360 degree field of view. Two types of lens shall be available, standard and extra dense.
17. Sensor shall have a variety of mask inserts for PIR coverage rejection to prevent false tripping.
18. Transducers shall be protected from tampering.
19. Sensor shall have manual adjustments for timer and sensitivities and override switches to force manual adjustment mode.
20. Sensor shall have adjustable sensitivity from 0% to 100% for both ultrasonic and infrared.
21. Controls shall be behind cover to resist tampering. All adjustments shall be accessible from the front of the sensor.

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22. Sensor shall be available with a photocell adjustment from 20 to 3,000 Lux.
23. Sensor shall provide internal operating status and settings confirmation via LED motion lamp indicator.
24. Sensor shall have two (if 180 degree) or three (if 360 degree) real time LED motion indicators visible from the front of the unit: Red = infrared; green = ultrasonic.
25. Subject to compliance with the above requirements, provide models of one of the following:
    a. Wattstopper-DT Series

D. 24 VDC POWER/CONTROL PACK: Where units are indicated, provide a power/control pack that meets the following minimum requirements:

1. Control module shall consist of a DC power supply and a dry contact relay for switching a lighting load.
2. Control module shall consist of a DC power supply and a dry contact relay for HVAC control.
3. Control module shall be available in versions to accept 120, and 277 VAC line voltages.
4. Output shall be 24VDC nominal, and shall be inherently safe, low voltage, limited power output (Class 2).
5. Output shall supply 100mA current, in addition to current consumed internally to operate internal relay.
6. Relay shall utilize normally open, silver alloy dry contacts, and shall be rated for a 20A ballast load at 120V and 277V.
7. Relay function shall not require more than 5 mA control current to operate.
8. Control module shall have line voltage wiring, consisting of input voltage and relay contact connections, exiting from one end, and low voltage DC connections, consisting of ground, power, and control wires, exiting from the other end.
9. Control module shall be sized to fit inside a standard 4” x 4” junction box.
10. Control module shall be equipped with a 1/2” EMT threaded male fitting on the line voltage end, such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external.
11. Control module shall be equipable with accessory 1/2” EMT threaded male fitting on the low voltage end, such that it may be mounted to the inside of a ballast cavity with the box and line voltage wiring internal to the cavity and the low voltage wiring external.
12. Slave module shall be available for switching additional circuits. Slave module has same construction and specifications as control module except without power supply function.
13. Subject to compliance with the above requirements, provide models of one of the following:
    a. Wattstopper-BEP Series

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

A. Install occupancy lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.

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B. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.

C. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Contractor shall be on site as required, to adjust lighting control units for proper operation.

E. Mount the switchpack in a standard 4" junction box. Mount sensor to a standard 4" junction boxes. Refer to manufacturer supplied mounting instructions.

F. All lighting programing shall meet the requirements of the IECC 2018 or current energy code applied to the project.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.

B. System start-up: Provide a factory authorized technician to verify the installation and test the system.

C. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

D. Contractor shall visit the job site 3 months after the owner has taken occupancy and adjust any units not operating properly, otherwise remove and replace with new units.

3.3 PRODUCT SUPPORT AND SERVICES:

A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:

1. The sensors have been fully installed in accordance with manufacturer's installation instructions.
2. Low voltage wiring for overrides and sensors is completed.
3. Accurate 'as-built' load schedules have been prepared.
4. Proper notification of the impending start-up has been provided to the owner's representative.
5. Programming of all switches, sensors, power packs, relays, etc. shall be completed by factory authorized technician, prior to final and training.

B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.

C. Functional Testing:

1. The owner shall hire a third party that will conduct and certify the functional testing.

2. Lighting controls devices shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working conditions in accordance with the construction documents, manufacturer's instructions and code requirements. The following shall be performed:

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a. Certify that sensors have been located, aimed and calibrated per manufacturer recommendations.

b. Status indicator operates properly.

c. Fixtures that are controlled by auto-on controls turn on to permitted level.

d. Fixtures that are controlled by manual on controls operate when manually activated.

e. Fixtures do not turn on incorrectly due to HVAC or movement outside the controlled area.

f. Confirm that occupancy sensors turn off after space is vacated and do not turn on unless space is occupied.

g. Simulate unoccupied conditions and confirm that vacancy sensors only turn on manually and turn off after space is vacated.

3. The party responsible for the functional testing shall provide documentation that the installed lighting controls meet or exceed all performance criteria and shall not be directly involved in the design or construction of the project.

3.4 WARRANTY:

A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.5 RECORD DRAWINGS:

A. Refer to Section 26 0502 for electrical Record Drawings Requirements (Following Lighting Controls).

3.6 MANUFACTURER AUTHORIZED PERSONNEL TRAINING:

A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating lighting control system equipment.

END OF SECTION 26 0923

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SECTION 26 0943

LIGHTING CONTROL EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide a lighting control system, including all system components, wiring, and any ancillary equipment necessary for a complete and working system. The system shall include all necessary components to achieve control and monitoring of all lighting fixtures, supporting both relay-switched and dimmed lighting solutions and controlled receptacles.

B. Electrical drawings show general zoning intent and lighting control narrative.

C. Energy Code: The system shall comply with latest edition of IECC energy code.

D. Types of lighting control equipment specified in this section, includes the following:

1. Low voltage relay control panels
2. Occupancy sensors
3. Daylight sensors
4. Wallstations/Switches
5. Lighting Load Controllers (Room Controllers)
6. Emergency Lighting Control Units/Generator Transfer Devices

E. Requirements are indicated elsewhere in these specifications for work including but not limited to raceways, electrical boxes and fittings required for installation of lighting control equipment, not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. To ensure a uniform installation and single responsibility, all switching and dimming equipment described herein shall be supplied by a single manufacturer.

B. Installer: Qualified with at least 3 years of successful installation experience on projects with lighting control equipment installation work similar to that required for project.

C. NEC Compliance: The control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.

D. NEMA Compliance: The control system shall comply with all applicable portions of the NEMA Standard regarding the types of electrical equipment enclosure.

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E. Codes and Standards: Provide units that meet the requirements of IEEE Std. 2000.1.1999.

F. Independent Testing Laboratory: Provide units that have been tested and listed under UL 916 energy management equipment.

G. Component Pre-testing: All control equipment shall undergo strict inspection standards. The equipment shall be previously tested and burned-in at the factory prior to installation.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide lighting control equipment of one of the following;

1. Wattstopper
2. Lutron (Per Alternate #1 and only if Accepted)
    a. Regarding Wireless Systems (If Provided):
        i. Provide a wireless lighting control system capable of controlling and managing lighting fixtures remotely without the need for physical wiring connections.
        ii. The system shall include the following components:
        iii. Wireless light switches or dimmers with integrated communication capabilities.
        iv. Central control hub or gateway for system management and communication.
        v. Wireless communication protocol compatible with industry standards, the manufacturer is responsible to ensure reliable connectivity.
        vi. User interface options including smartphone apps, web interfaces, and physical remote controls, occupancy sensors, and touchscreens as defined by the electrical drawings and narrative.

B. Manufacturer's representative for division 26 and bidding controls shall be accountable for the comprehensive lighting controls package's finalization in alignment with the design intent depicted in the drawings and complying with IECC 2021 requirements. The lighting representative is required to develop detailed shop drawings demonstrating the lighting control system's topology and the essential connections necessary for its proper functioning. Lighting control devices shown are to provide general intent only. Manufacturers representative to provide all additional devices and modify device locations as required to meet IEC 2021 requirements

2.2 SYSTEM DESCRIPTION:

A. The lighting control system shall provide seamless control and monitoring of all lighting included in the scope of work regardless of whether it is relay switched or dimmed.

B. The lighting control system shall consist of low voltage relay control panels with programmable switch inputs, the panel shall be microprocessor controlled with a

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touchscreen interface display. The touchscreen shall provide relay status information viewable through a protected windowed enclosure. All local programming shall be permissible through the self-prompting touchscreen.

C. Programmable intelligence shall include:

1. Time of day control (64 time-of-day/holiday schedules)
2. 32 holiday dates
3. Timed inputs (adjustable from 1 to 99 minutes)
4. Timed override (from touchscreen, adjustable from 1 to 999 minutes, then resumes normal schedule)
5. Pre-set controls
6. Auto daylight savings adjust
7. Low voltage Dimming/Central Dimming Controls:
    a. 0-10V dimming capability
    b. Daylighting control via 0-10V dimming relays and programming
    c. DMX or other dimming protocols as indicated on plans
8. Astronomical clock with offsets
9. Local control (from touchscreen and local switch)
10. Digital wallstations/switches
11. Flash warning of impending off for occupants
12. Network override

D. The controller shall permit lighting to be overridden on for after-hours use or cleaning. The controller shall provide priority and masking choices to allow for customizing the functions of switch inputs, thereby enabling wallstations/switches to function differently at different times of day. These overrides shall be digital, network or hard-wired inputs.

E. The lighting control system shall be fully programmable through PC programming software. Programming shall be permitted through a direct RS-232 connection, modem or TCP/IP.

1. Shall include with user-friendly software suitable for operation on computer workstations which serve as central control stations for the selection and operation of lighting scenes.

2. All software shall be programed by the vendor and delivered ready to use. This program shall include preparation of all graphics, and displays required as a part of this project.

F. The control system shall provide networking between lighting control panels. The network shall support up to a maximum of 254 control panels. Panels shall permit data sharing for global controls. All inputs shall be transferable over the network to create any switching pattern.

G. The lighting control system shall log all control events. Log reports shall be available through the integral touchscreen or enterprise software.

H. All lighting programing shall meet the requirements of the IECC 2021 or current energy code applied to the project.

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2.3 EQUIPMENT:

1. Low Voltage Dimming (0-10V):
    a. Capable of controlling any 0-10V source with the required dimming channels.
    b. 0-10V analog voltage signal.
    c. Provide isolated 0-10V output signal conforming to IEC 60929.
    d. Sink current via IEC 60929.
    e. Source current.
2. Indoor Lighting: Provide a sensor with a Fresnel lens providing for a 60° cone shape response area. The unit shall work with a range between 10-100 foot-candles.
3. Wallstations: Provide low voltage push-button type switches up to 8 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wallstation shall connect to the room controller via the room controller local network. Wallstations that require user interface to allow for raise/lower control of dimming, loads shall include a slider function or similar. All wallstations shall have the ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.
4. Provide wiring in conduit located within the walls and non-accessible ceilings. Provide wiring above accessible ceilings in conduit to system enclosure to system enclosure.

B. Room Controllers:

1. The room controller shall provide the following functionality;
    a. Provide interface with room occupancy sensor to provide lighting and receptacle control and be programmable as either manual on/automatic off. Provide interface with room wallstations to provide multi-level switching and/or variable dimming. Provide interface with daylight sensors to provide daylighting controls of lighting fixture via multi-level (step dimming) and/or variable dimming.
2. The room controller shall be a fully functional lighting control system to match the room lighting and control requirements. The controller shall provide the following features:
    a. Separate compartments for line voltage, emergency voltage and low voltage connections.
    b. Breakouts for direct conduit connections.
    c. Dual voltage (120/277 VAC)
    d. Low voltage connections using standard RJ-45 connectors.
    e. Zero cross circuitry for each load.
    f. Relay and 0-10V dimming zone configuration to match room requirements.
    g. The ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.

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3. Emergency Lighting: When the room controller is provided with emergency relay, the controller shall be UL 924 Listed and monitor the normal power circuit. The UL 924 relay will track the normal power operation. Upon loss of normal power the emergency lighting will be forced on to full bright (if dimming) until normal power is restored. The following features shall be included:
    a. 120/277 VAC
    b. Push-to-test
4. Daylight sensors shall work with the room controller to provide automatic daylight dimming capabilities for loads connected to the room controller. The daylight sensor shall include the following features:
    a. An additional photodiode that measures only the visible spectrum.
    b. The sensor shall have three light level ranges;
        i. Low (3-300 LUX), high (30-3000 LUX) and direct sun (300-30,000 LUX).
    c. The sensor shall provide the capability of controlling multiple (up to three) daylight zones for dimming daylight harvesting.
    d. The sensor shall include an internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
5. Ceiling Mounted Occupancy Sensors: Sensors shall utilize dual-technology (ultrasonic and infrared technologies) and have the following additional features:
    a. Sensor shall be class 2, low voltage; capable of mounting in the ceiling for maximum coverage.
    b. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
    c. Sensor shall have 360 degree field of view.
    d. Sensor shall incorporate non-volatile memory such that all settings and parameters are saved in protected memory.
    e. Sensor shall have time delays from 10 to 30 minutes.
    f. Sensor shall provide a visual means of indication that motion is being detected via an LED.
    g. Sensors shall have readily accessible, user adjustable settings for time delay and sensitivity.
    h. Provide internal additional isolated relay with NO, NC and common outputs for use with HVAC control, data logging and other control options.
6. Wallstations: Provide low voltage push-button type switches up to 8 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wallstation shall connect to the room controller via the room controller local network. Wallstations that require user interface to allow for raise/lower control of dimming, loads shall include a slider function or similar. All wallstations shall have the ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.

C. Emergency Power Control (CEPC)/ Emergency Lighting Control Units (ELCU)/Generator Transfer Devices (Required when not built into Room Controller, Relay Panel, etc):

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1. The Emergency Power Control (CEPC)/Lighting Control Unit (ELCU) shall provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building. The unit shall be installed flush to the ceiling so that test switch & LED's are in plain view of room occupants as required by some local electrical codes.

2. The device shall automatically illuminate connected emergency loads upon utility power interruption, regardless of room switch position. (NEC 700.24)

3. Local room switch or lighting control shall turn both regular & emergency luminaires on at the same time (no dedicated emergency room switch required).

4. The emergency lighting control unit shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.

5. The unit shall be compatible with 2-wire, 3-wire, 0-10V, & DALI dimming systems & ballasts.

6. The device shall be self-contained, measure 1.70" x 2.97" x 1.64," and provide integral one half inch pip nipple mount with snap in locking feature for mounting into a standard junction box KO.

7. The device shall have normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.

8. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.

9. The device shall have an integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.

10. The unit shall provide dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.

11. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).

12. The device's normal power input lead shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.

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13. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.

14. The unit shall utilize zero crossing circuitry to protect relay contacts from the damaging effects of inrush current generated by switching electronic ballast loads.

15. The unit shall have UL 94-V0 or UL 94-5VA flame rating & be approved for installation above the suspended ceiling.

16. To ensure quality and reliability, the unit shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

17. The device shall not generate any objectionable electrical or mechanical noise.

18. The unit shall be UL and cUL listed and labeled for connection to both normal and emergency lighting power sources.

PART 3 - EXECUTION:

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.

B. Comply with Requirements of NEC, and applicable portions of NECA's 'Standard of Installation' pertaining to general electrical installation practices.

C. Coordinate with other electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.

D. Electrical Identification: Refer to Section 26 0553 for requirements.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.

B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

3.3 PRODUCT SUPPORT AND SERVICES:

A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:

1. The control system has been fully installed in accordance with manufacturer's installation instructions.
2. Low voltage wiring for overrides and sensors is completed.
3. Accurate 'as-built' load schedules have been prepared for each lighting control panel.

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4. Proper notification of the impending start-up has been provided to the owner's representative.
5. Programming of all wallstations/switches, relays, groups of relays and interfaces with building automation shall be completed by factory authorized technician, prior to final and training.

B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.

3.4 PROGRAMMING:

A. Program of all lighting control systems as directed by the electrical engineer and/or owner. Meet with the electrical engineer at their office prior to preparation of shop drawings to discuss specific programming and zoning requirements of system(s). Each networked or standalone system shall be programmed to revert back to its normal "ON" position one hour after selecting a scene or raising or lowering a lighting zone.

B. All lighting programing shall meet the requirements of the IECC 2021 or current energy code applied to the project.

C. Integrate lighting controls into classroom or room AV touch Screen and Shade Controller. Provide interface as required. Coordinate with AV integrator to integrate with Touch Panel and GUI within the room. Lighting shall provide multiple presets and slider control options.

1. Sensors can be used to trigger automated settings for shades and projector screens based on room occupancy, ambient light level, etc.

2. Program lighting and shades, per owner's requirements, to operate in accordance with the defined lighting presets within the space.

3.5 COMMISSIONING:

A. A lighting control system requires at least one site visit for proper commissioning. If multiple site visits are required, the first ensures that the contractor is trained to install the system correctly. On the second, the factory trained engineer will start up the system, ensure that it is operating according to specification, and perform initial programming. The third visit is for the purposes of refining the programming, and training the owner/end user on the system.

B. Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:

1. Certified by the equipment manufacturer on the system installed.

2. Site visit activities:

a. Verify connection of power feeds and load circuits.

b. Verify connection of controls.

c. Verify system operation control by control, circuit by circuit.

d. Obtain sign-off on system functions.

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e. Demonstrate system capabilities, operation and maintenance and educate Owner's representative on the foregoing.

3. At least three site visits to accomplish the following tasks:

a. Prior to wiring:

i. Review and provide installer with instructions to correct any errors in the following areas:

1. Low voltage wiring requirements
2. Separation of high and low voltage wiring runs
3. Wire labeling
4. Load schedule information
5. Switching cabinet locations and installation
6. Physical locations and network addresses of controls
7. Ethernet connectivity
8. Computer-to-network connections
9. Load circuit wiring
10. Connections to other systems and equipment
11. Placement and adjustment of Occupancy Sensors
12. Placement and adjustment of Photocells

b. After system installation:

i. Check and approve or provide correction instructions on the following:

1. Connections of power feeds and load circuits
2. Connections and locations of controls
3. Connections of low voltage inputs
4. Connections of the data network

ii. Turn on system control processor and upload any pre-programmed system configuration

iii. Verify cabinet address(es)

iv. Upload pre-programmed system configuration and information to switching and/or dimming cabinets

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v. Check load currents and remove bypass jumpers

vi. Verify that each system control is operating to specification

vii. Verify that each system circuit is operational according to specification

viii. Verify that manufacturers' interfacing equipment is operating to specification

ix. Verify that any computers and software supplied by the manufacturer are performing to specifications

x. Verify that any remote WAN (Wide Area Network) connections are operating properly

xi. Have an owner's representative sign off on the above-listed system functions

c. Before project completion and hand-off:

i. Demonstrate system capabilities and functions to owner's representative

ii. Train owner's representative on the proper operation, adjustment, and maintenance of the system.

C. Notification: Upon completion of the installation, the contractor shall notify the manufacturer that the system is ready for formal checkout. Notification shall be given in writing a minimum of 21 days prior to the time factory-trained personnel are required on site. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to manufacturer prior to scheduling commissioning activity. Manufacturer shall have the option to waive formal turn-on.

D. Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Certified Technician shall completely check the installation prior to energizing the system. Each installed relay system shall be tested for proper ON/OFF operations, and proper LED illumination. Each installed control cabinet shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminate properly.

E. Provide written commissioning report including space/room names and numbers indicating list of all lighting equipment and devices tested and verifying proper operation of the system. Report shall include corrections, programming information/file, warranties, and owner's representative sign off on the above-listed system functions.

F. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.6 RETRO-COMMISSIONING:

A. During the one year warranty period, provide retro-commissioning services at three month, six month, nine month, and one year marks. Provide at least 4 hours of commissioning service for each of the four retro-commissioning periods. This will include meeting with the Owner to receive feedback on the system and making changes to the

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system including programming, task tuning.

3.7 MAINTENANCE:

A. Enable the end user to order new equipment for system expansion, replacements, and spare parts.

B. Make new replacement parts available for a minimum of ten years from the date of manufacture.

C. Manufacturing shall provide telephone technical support by factory personnel 24 hours a day, 7 days a week. Project cost overruns and delays can occur without this service. Answering services can add to frustration and delay the resolution of any problems or issues. Manufacturers who do not offer factory-direct technical support on a 24/7 basis should not be acceptable on this project.

D. Provide factory-direct technical support hotline 24 hours per day, 7 days per week.

E. Offer renewable annual service contracts, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system commissioning.

3.8 WARRANTY:

A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.9 RECORD DRAWINGS:

A. Refer to Section 26 0502 for electrical O & M requirements.

3.10 TRAINING:

A. Provide four (4) hours of recorded training in two 2 hour sessions on the operation and use of the lighting control equipment, at job site, at no cost to the Owner.

B. Provide a USB Flash device to the owner containing the information specified below. The media shall include all information required to allow the Owner to change the schedules themselves. The media shall contain a minimum of following:

1. CAD drawing files of ‘as-built’ lighting control components and point to point connections.

2. General configuration programming.

3. Job specific configuration programming to include schedule.

C. Tutorial file on complete programming of lighting control system

END OF SECTION 260943

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SECTION 26 1010

ENERGY & POWER METERING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and methods sections apply to work of this section except as otherwise indicated. See Section 26 2713 Service Entrance, Section 26 2413 Switchgear and Switchboards, and Section 26 2416 Panelboards.

1.2 DESCRIPTION OF WORK:

A. Provide equipment to measure, monitor, acquire and store electrical metering data, and to communicate energy and power data to the building BAS/BMS (Building Automation System/Building Management System). Communication of data to the BAS/BMS system shall use the BACnet protocol.

B. System shall include, but not be limited to, electronic primary meters and sub-meters, meter/monitor devices, current and voltage transformers as required, microprocessors, communications network, communications modules and network equipment, and all ancillary equipment to provide a complete and operating Energy and Power Metering System.

C. System shall measure kWh energy use, kW power, power factor, frequency, voltage and current data, and shall store and communicate this data separately for the following individual load categories: Total HVAC System; Interior Lighting; Exterior Lighting; Plug Loads; Process Load; and Building Operations and Other Miscellaneous Loads.

TABLE C405.12.2
ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY USE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	Any single load that is not included in an HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment and commercial kitchens.
Building operations and other miscellaneous loads	The remaining loads not included elsewhere in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

D. System shall also comply with 2021 IECC C405.12 Energy Monitoring Measurement Requirements and Energy Monitoring Credit 406.10.

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E. System shall store all meter data for at least 36 months.

F. PRIMARY METERING: Primary metering equipment shall be utility-grade equipment. Functions provided by the Energy and Power Metering System equipment and components in this section include the following:

1. Data acquisition, data storage and communication to the the building BAS/BMS system
2. Overall building electrical energy use data in kWh stored and communicated to the BAS/BMS at 15-minute intervals
3. Overall building electrical power demand data in kW stored and communicated to the BAS/BMS at 15-minute intervals
4. Overall building electrical power factor data stored and communicated to the BAS/BMS at 15-minute intervals.
5. Building voltage data stored and communicated to the BAS/BMS at 15-minute intervals
6. Building current data in amperes stored and communicated to the BAS/BMS at 15-minute intervals

G. SUBMETERING: Submetering equipment shall be revenue-grade equipment. Functions provided by the Energy and Power Metering System equipment and components in this section include the following:

1. **Total HVAC System** equipment electrical energy in kWh, power demand in kW, voltage and current data stored and communicated to the BAS/BMS at 15-minute intervals
2. **Interior Lighting** energy in kWh, power demand in kW, voltage and current data stored and communicated to the BAS/BMS at 15-minute intervals
3. **Exterior Lighting** energy in kWh, power demand in kW, voltage and current data stored and communicated to the BAS/BMS at 15-minute intervals
4. **Plug Load** energy in kWh, power demand in kW, voltage and current data stored and communicated to the BAS/BMS at 15-minute intervals
5. **Process Load** energy in kWh, power demand in kW, voltage and current data stored and communicated to the BAS/BMS at 15-minute intervals
6. **Building Operations and Other Miscellaneous Loads** energy in kWh, power demand in kW, voltage and current data stored and communicated to the BAS/BMS at 15-minute intervals

H. Any additional equipment and accessories required for a fully functional metering system to meet the intent of the specifications shall be provided whether or not specifically listed herein.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable pertaining to construction and installation of electrical/electronic metering systems and equipment.

B. Comply with applicable requirements of UL safety standards pertaining to electrical/electronic metering systems and equipment. Provide equipment that has been UL listed and labeled.

C. All work shall be done by expert technicians qualified in the field with knowledge of metering systems and experience installing similar systems.

D. The manufacturer's qualified technician shall calibrate, test and adjust the metering system

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and make all final connections to the metering equipment

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. The acceptable manufacturers listed below shall provide Energy and Power Metering System equipment and install the necessary equipment within their electrical switchboards and panelboards.

B. Subject to compliance with requirements, provide products of one of the following:

1. Leviton Manufacturing Co. Inc. (Basis of Design)
2. Cutler-Hammer Products, Eaton Corp.
3. General Electric Co.
4. Siemens Energy & Automation, Inc.
5. Square D Co.

2.2 EQUIPMENT AND COMPONENTS:

A. GENERAL: Energy and Power Metering system:

1. Shall measure, meter, record and store electrical energy and power data.
2. Shall automatically communicate electrical energy and power data.
3. The system shall utilize multiple submeters and power monitor devices throughout the electrical distribution system, located in multiple switchboards and panelboards that serve lighting, plugloads, hvac equipment and laboratories. The system shall acquire and store energy and power data from the primary meter and from each of the submeters/power monitor devices over a network, with the result that the data shall is centralized in the Central Energy & Power Display/Processor. The Central Energy & Power Display/Process shall communicate the data to the BAS/BMS systems.
4. All set-up parameters shall be stored in non-volatile memory and retained in the event of a control power failure.

B. PRIMARY METER equipment shall be a utility-grade device, located within manufacturer's switchboard. Meter equipment monitor devices shall:

1. be designed for use with current inputs from standard instrument current transformers.
2. shall measure line-to-line voltage each phase, line-to-neutral voltage each phase, line current each phase, frequency, power in kW of each phase (and total), apparent power each phase (and total).
3. shall calculate line-to-line average 3-phase voltage, average current, total power demand in kW, power factor, and accumulated energy in kWh.

C. SUBMETER equipment shall be revenue-grade devices,. located within manufacturer's switchboards and panelboards. Meter equipment monitor devices shall:

1. be designed for use with integral current sensors or external current transformers
2. shall measure line-to-line voltage each phase, line-to-neutral voltage each phase, line current each phase, frequency, power in kW of each phase (and

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total), apparent power each phase (and total).

3. shall calculate line-to-line average 3-phase voltage, average current, total power demand in kW and accumulated energy in kWh.

D. POWER MONITOR DEVICES:

1. similar to Leviton "Leviton VerifEye Metering System"
2. integral built-in current transformers up to 400 amperes
3. monitors watts, watt-hours, watt demand, currents, voltages, frequency, reactive power, apparent power factor and displacement power factor

E. CURRENT TRANSFORMERS:

1. Solid-core transformers, with ratings corresponding to the feeder breaker current rating.
2. plus or minus 2% accuracy
3. UL listed

F. CENTRAL ENERGY & POWER DISPLAY/PROCESSOR:

1. Microprocessor-based.
2. Shall acquire and store energy and power data from primary meter, submeters and power monitor devices.
3. Shall communicate data to the BAS/BMS. Shall report data at 15-minute intervals as specified and described in paragraphs 1.2.F and 1.2.G.
4. Shall store all metering data for at least 36 months.
5. Shall report hourly, daily, monthly and annual energy use for each primary meter, submeter and power monitor device to comply with 2021 IECC 405.12/406 Energy Metering requirements.

G. COMMUNICATION COMPONENTS AND NETWORKS:

1. Provide communications and control network, network hardware, software to effect acquisition of energy and power data between the Central Energy & Power/Display Processor and primary meter, submeters and power monitor devices. Include all interconnection connectivity, active equipment, communication interfaces, wires and cables as required.
2. Provide communications modules, hardware, interface cards, etc. and software to communicate between the Central Energy & Power Display Processor and the building BAS/BMS system.

H. CABLE SYSTEMS:

1. RS-485 Cable: PVC jacketed, paired, 2 pairs, twisted, No. 22 gauge minimum, stranded.
2. Unshielded Twisted Pair - Category 6 minimum, as specified in Telecom cabling section.
3. Other cables: as recommended by Energy & Power Metering system manufacturer.
4. Certified for use at data speeds up to at least 100 Mbps.

I. FACTORY REQUIREMENTS:

1. Energy and Power meters, submeters, power monitoring devices and ancillary components shall be factory-installed, wired and tested prior to shipment to the jobsite.

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2. All control power, CT, PT and data communications wire shall be factory-wired, harnessed and terminated within the switchboards, panelboards and equipment enclosures.

3. Where external connections are required, terminal blocks shall be provided and the manufacturer's drawings shall clearly identify the interconnection requirements for external wiring, including wire type to be used.

PART 3 - EXECUTION

3.1 INSTALLATION OF ENERGY AND POWER METERING SYSTEM:

A. Install equipment and components in accordance with manufacturer's written instructions with recognized industry practices to ensure that installation complies with requirements of NEMA and NEC standards, and applicable portions of NECA's "Standard of Installation".

B. Energy and Power monitoring components shall be factory installed, wired and tested prior to shipment to the jobsite.

C. Network hardware shall be installed in accordance with the manufacturer's instructions.

D. Software (as applicable) shall be designed specifically for energy, power monitoring and control. The software shall be a standard product offering with no customization required. The software shall be configured by the manufacturer's qualified technician.

E. Electrical Identification: As required by the manufacturer, and as specified in Section 260553 Electrical Identification for requirements.

3.2 WIRING:

A. All wiring external to metering equipment, switchboards and panelboards shall be installed in metallic conduit and provided with necessary junction and pull boxes. The electrical contractor shall provide all wiring and conduit, boxes, and rough-in. Wiring types and characteristics shall comply with equipment manufacturer recommendations. Care shall be exercised in wiring installation to avoid damage to the cables. Cables shall be pulled continuous without splicing, leaving ends in lengths as directed by the manufacturer's qualified technician.

B. After all wiring, circuits and cables have been pulled and completed from one extremity to the other, the electrical contractor shall check all wiring free of opens, shorts and grounds.

C. Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground.

D. The manufacturer's qualified technician shall calibrate, test and adjust the metering system and make all final connections to the metering equipment.

3.3 FIELD QUALITY CONTROL:

A. Prior to system energization, check all power and control wiring for electrical continuity and communications wiring for signal integrity.

B. EQUIPMENT CHECK-OUT: Provide equipment check-out by manufacturer's trained and authorized technician.

C. TESTNG: Upon completion of installation of system, demonstrate system operation, capability and compliance with requirements. Where possible, correct malfunctioning equipment at site, then retest to demonstrate compliance. Otherwise, remove and replace with new equipment, and proceed with retesting.

D. Subsequent to wire and cable connections, energize electrical system and demonstrate functioning in accordance with requirements.

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3.4 TRAINING:

A. Provide a minimum of four hours of in-service training with owner personnel.

END OF SECTION 26 1010

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SECTION 26 2200

TRANSFORMERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of transformer work is indicated by drawings and schedules. Work includes complete installation and electrical connections.

B. Types of transformers in this section include the following:

1. Dry-type Distribution Transformers

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to installation and construction of electrical power/distribution transformers; with applicable portions of NEMA Std. Pub. Nos. TR1 and TR27; and with applicable ANSI/IEEE standards pertaining to power/distribution transformers.

B. Comply with applicable portions of ANSI/UL 506; "Safety Standard for Specialty Transformers". Provide distribution transformers that have been UL listed and labeled.

C. All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI/IEEE, NEMA, and Department of Energy standards.

1. C57.12.00 – IEEE Standard for Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

2. C57.12.28 – Pad-Mounted Equipment - Enclosure Integrity.

3. C57.12.34 – IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVA and Smaller) - High Voltage: 34500GrdY/19920 Volts and Below; Low-Voltage: 480 Volt 2500 kVA and Smaller (issued in March 2005 - combines C57.12.22 and C57.12.26).

4. C57.12.90 – IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short-Circuit Testing of Distribution and Power Transformers.

5. C57.12.91 – Guide for Loading Mineral-Oil-Immersed Transformers.

6. NEMA TR 1-1993 (R2000) – Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels for Liquid-Immersed Power Transformers.

7. NEMA 260-1996 (2004) – Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas.

8. 10 CFR Part 431 – Department of Energy – Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.

9. NEMA ST-20 - Dry-Type Transformers for General Applications

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10. NEMA TP-1-2002 – Standards for transformer energy efficiency.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 DRY -TYPE DISTRIBUTION TRANSFORMERS:

A. GENERAL: Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.

B. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type of transformer):

1. Acme Transformer Company
2. GE/ABB
3. Cutler Hammer Products, Eaton Corp.
4. Federal Pacific
5. Hevi-Duty Electric Div., General Signal Corp.
6. Jefferson Electric
7. Schneider Electric/Square D Co.
8. Hammond Power Solutions
9. Siemens Energy & Automation, Inc.

C. DRY-TYPE DISTRIBUTION TRANSFORMERS (GENERAL PURPOSE):

1. Provide factory-assembled, general-purpose, air-cooled, aluminum wound dry-type distribution transformers where shown; of sizes, characteristics, and rated capacities indicated. Provide primary winding with minimum of 4 full capacity taps; each 2-1/2 percent, two above and two below full-rated voltage for de-energized tap-changing operation.
2. Insulate with 220 degree C. UL recognized insulation system for 150° degree C rise above 40o ambient at full load.
3. Limit sound levels to the following (as determined by ANSI/NEMA standards):
   a. 30-50 KVA 45 dB
   b. 51-150 KVA 50 dB
   c. 151-300 KVA 55 dB
   d. 301-500 KVA 60 dB
   e. 501-1000 KVA 64 dB
4. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections. Equip terminal leads with connectors installed, suitable for copper or aluminum wiring. Cushion-mount transformer with vibration isolation supports. Provide transformers with ventilated, heavy gauge sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for wall and floor mounting as indicated.
5. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 2.

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Table 2 Percent Impedance Voltage (Dry-Type)	
KVA Rating (Secondary Voltage < 700 V)	Impedance
0 - 75	3.00 – 5.75%
112.5 - 225	4.00 - 5.75%
300 and above	5.00 - 5.75%

D. DRY-TYPE DISTRIBUTION TRANSFORMERS (K-RATED):

1. Provide factory-assembled, air-cooled, copper wound dry-type distribution transformers where shown; of sizes, characteristics, and capacities indicated, and UL listed for non-sinusoidal current loads of K-factor 13 (shown on drawings). See ANSI/IEEE C57.110-1986 for K-factor and UL Std 1561. Provide primary windings with a minimum of 4 full capacity taps; each 2-1/2 percent, two above and two below full-rated voltage for de-energized tap changing operator.

2. Insulate with 220 degree C UL recognized insulation system for 150° degree C rise above 40oC ambient at full load.

3. Include an electrostatic shield for attenuation of spikes, line noise, and transients. Wind coils with foil wrap to minimize effects caused by harmonic currents above the fundamental frequency. Provide transformer with neutral conductor and lugs sized at two times rated phase current.

4. Limit sound levels to the following:

   a. 30-50 KVA 45 dB

   b. 51-150 KVA 50 dB

   c. 151-300 KVA 55 dB

   d. 301-500 KVA 60 dB

   e. 501-1000 KVA 64 dB

5. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections. Equip terminal leads with connectors installed, suitable for copper or aluminum wiring. Cushion-mount transformer with vibration isolation supports. Provide transformers with ventilated, heavy gauge sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for wall and floor mounting as indicated.

6. The percent impedance voltage, as measured on the rated voltage connection, shall be per Table 3.

Table 3 Percent Impedance Voltage (Dry-Type, K-rated)	
KVA Rating (Secondary Voltage < 700 V)	Impedance
0 - 75	3.00 – 5.75%
112.5 - 225	4.00 - 5.75%
300 and above	5.00 - 5.75%

PART 2 – EXECUTION

2.1 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

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B. Coordinate transformer installation work with electrical raceway and wire/cable work, as necessary for proper interface.

C. Connect transformer units to electrical wiring system; comply with requirements of other Division-26 sections.

D. MOUNTING: Provide concrete pad under all floor mounted equipment and equipment mounted at grade. Anchor transformer to pad with 3/8" expansion anchors at each corner of enclosure. Provide vertical and lateral support systems for all transformers that are supported from overhead structure. See drawings for support and attachment details. Provide neoprene vibration isolators at each anchor point.

E. GROUNDING: Provide tightly fastened equipment grounding and bonding connections for transformers.

F. TESTING: Upon completion of installation of transformers, energize primary circuit at rated voltage and frequency from normal power source and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 26 2200

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SECTION 26 2413

SWITCHGEAR AND SWITCHBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and methods sections apply to work of this section except as otherwise indicated. See Section 262713 Service Entrance, for metering requirements. See Section 264313 for SPD requirements.

1.2 DESCRIPTION OF WORK:

A. Extent of switchgear and switchboards is indicated by drawings and schedules.

B. Types of switchgear and switchboards in this section include the following:

1. AC Dead Front Switchboards (600V)

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to construction and installation of electrical switchgear and switchboards. Provide switchgear and switchboards that have been UL listed and labeled.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products of one of the following (for each type of switchgear and switchboard):

B. AC DEAD FRONT SWITCHBOARDS (600V):

1. Square D Co. (Basis of Design)
2. Cutler-Hammer Products, Eaton Corp.
3. GE/ABB
4. Siemens Energy & Automation, Inc.

2.2 EQUIPMENT SECTIONS AND COMPONENTS:

A. GENERAL: Except as otherwise indicated, provide switchgear and switchboards of types, sizes, characteristics, and ratings indicated, that comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, and as required for a complete installation. See drawings and Section 262815. Series rated systems are not accepted.

B. Overcurrent Protection Devices, for main and branch devices. Provide switchgear, switchboards, and overcurrent devices of one manufacturer.

C. Provide each service entrance switchboard with surge protective device (SPD) mounted in a separate enclosure adjacent to the switchboard/switchgear. See Section 264313 for

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SPD unit requirements. Provide in-line fusing for each phase of the device, and wire in accordance with manufacturer's instructions, with conductor length not exceeding 18".

2.3 AC DEAD-FRONT SWITCHBOARDS (600V):

A. Provide factory assembled, dead front, metal enclosed, floor standing, self supporting, group mounted, secondary power switch boards, of sizes, electrical ratings and characteristics indicated consisting of panel (vertical) units, and containing circuit breaker and fusible switch assemblies of quantities, ratings and types indicated. Provide aluminum main bus and connections to switching devices of sufficient capacity to limit rated continuous current operating temperature rise to UL standard; with main bus and tap connections silver-surfaced or tin-plated and tightly bolted for maximum interrupting capacity. Provide accessibility of line and load terminations from front of switchboard. Prime and paint switchboard with manufacturer's standard finish and color. Equip units with built-in lifting eyes and yokes; provide individual panel (vertical) units, suitable for bolting together at project site, and constructed for the following environment:

1. Installation: Indoors, NEMA Type 1.

B. Limit height of upper most overcurrent device handle to 6'-2" to accommodate 4" curb.

PART 3 - EXECUTION

3.1 INSTALLATION OF SWITCHGEAR AND SWITCHBOARDS:

A. Install switchgear and switchboards where shown, in accordance with manufacturer's written instructions with recognized industry practices to ensure that switchgear and switchboards comply with requirements of NEMA and NEC standards, and applicable portions of NECA's "Standard of Installation".

B. Install all switchgear and switchboards on 4" high concrete curb and bolt equipment to curb with 5/8" anchors at each corner and at intervals not to exceed 4 feet along perimeter. Install concrete wiring trench under switchgear and switchboards; 18" deep, and 4" smaller in length and width than equipment base. Install grounding bushings on conduits penetrating trench.

C. Arrange conductors within switchgear and switchboards in neat fashion, and secure with suitable ties.

D. Tighten fuses, if any, in each switchgear and switchboard.

E. Provide and install spare fuse cabinet in main electrical room.

F. Electrical Identification: Refer to Section 260553 for requirements.

G. Provide a surge protective device on each switchboard located on the emergency distribution system. Refer to Section 26 4313 for requirements.

3.2 ADJUST AND CLEAN:

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL:

A. Prior to energization of switchgear and switchboards, check with ground resistance tester phase to phase and phase to ground insulation resistance levels to ensue requirements are fulfilled.

B. Prior to energization, check switchgear and switchboards for electrical continuity of circuits, and for short circuits.

C. Subsequent to wire and cable connections, energize switchgear and switchboard and

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demonstrate functioning in accordance with requirements.

END OF SECTION 26 2413

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SECTION 26 2416

PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to panelboards specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of panelboard and enclosure work, is indicated by drawings and schedules.

B. Types of panelboards and enclosures in this section include lighting and appliance panelboards, and power distribution panelboards.

1.3 QUALITY ASSURANCE:

A. Provide units that have been UL listed and labeled. Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC pertaining to installation of wiring and equipment in hazardous locations. Comply with NEMA Stds. Pub No. 250, "Enclosures for Electrical Equipment (1000 volt maximum). Pub No. 1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide of one of the following:

1. Square D Company (Basis of Design)
2. Cutler Hammer Products, Eaton Corp.
3. GE/ABB
4. Siemens Energy & Automation, Inc.

2.2 PANELBOARDS:

A. GENERAL:

1. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated. Equip with number of unit panelboard devices as required for complete installation. Fully equip "spaces" with hardware to receive breaker or switch of size indicated. Provide CU/AL rated lugs of proper size to accommodate conductors specified.

B. POWER DISTRIBUTION PANELBOARDS:

1. Provide dead-front safety type power distribution panelboards as indicated, with switching and protective devices in quantities, ratings, types and with arrangement shown. Equip with aluminum bus bars, full-sized neutral bus and

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ground bus. Provide fusible or circuit breaker branch and main devices as indicated. Series rated systems are not acceptable. See Section 262815, Overcurrent Protection Devices.

C. LIGHTING AND APPLIANCE PANELBOARDS:

1. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types, and arrangement shown. Provide bolt-on thermal magnetic type branch breakers. Where multiple breakers are indicated, provide with common trip handle. Series rated systems are not acceptable. Equip with aluminum bus bars, full-sized neutral bus, and ground bus.

D. PANELBOARD ENCLOSURES:

1. Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage minimum 16-gage thickness. Provide door-in-door hinged fronts. Provide fronts with adjustable indicating trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor. Provide enclosures fabricated by same manufacturer as overcurrent devices contained therein Bolt engraved plastic laminate labels indicating panel name and voltage on the interior and exterior of panelboards.
2. Provide floor to ceiling panel extensions for all surface mounted panels located outside of mechanical and electrical rooms.

E. FINISH:

1. Coat interior and exterior of surface with manufacturer's standard color; baked on enamel finish.

F. ELECTRICAL IDENTIFICATION:

1. Refer to Section 260553 for requirements.

PART 3 – EXECUTION

3.1 INSTALLATION OF PANELBOARDS:

A. GENERAL:

1. Install panelboards and enclosures where indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", in compliance with recognized industry practices to ensure products fulfill requirements.
2. Provide a surge protective device on each panelboard located on the emergency distribution system. Refer to section 26 4313 for requirements.

B. MOUNTING:

1. Provide 4" high concrete curb under floor standing distribution panelboards.
2. Coordinate installation of panelboards and enclosures with cable and raceway installation work. Anchor enclosures firmly to walls and structural surfaces, ensuring they are permanently and mechanically secure. Arrange conductors neatly within enclosure, and secure with suitable nylon ties. Fill out panelboard's circuit directory card upon completion of installation work. Utilize actual final building room numbers, not architectural numbers used on drawings. Identify individual lighting circuits and individual receptacle circuits by room served. Label circuit breakers to identify location of subpanel or equipment supplied using room numbers and equipment names. Include room number with equipment circuit designations. All directories to be typewritten.

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SECTION 26 2713

SERVICE ENTRANCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of service-entrance work is indicated by drawings and schedules.

B. Switchboards, panels, disconnects, transformers, etc., used for service-entrance equipment are specified in applicable Division-26 sections, and are included as work of this section.

C. Consult local utility relative to all costs for line extensions, connections, etc., and include all costs for bringing service to the facility in base bid. Confirm location of point of service before bidding.

D. Provide labor and materials as required to accomplish power company metering in accordance with power company standards and requirements.

E. Provide concrete pads of size and type required for service transformers. Verify location, size, openings, reinforcing requirements with Rocky Mountain Power (RMP/Local Utility) before beginning work. Comply with RMP clearance requirements.

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of service-entrance equipment and accessories. Provide service-entrance equipment and accessories that are UL-listed and labeled, and equipment marked, "Suitable for use as Service Equipment".

B. Provide and locate properly sized concrete padsvaults for power company furnished pad/vault mounted transformers in accordance with power company clearance requirements.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 SERVICE - ENTRANCE EQUIPMENT:

A. GENERAL: Provide service-entrance equipment and accessories, of types, sizes, ratings and electrical characteristics indicated, that comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation, and as herein specified.

B. Provide each service entrance switchboard with Surge Protective Devices as required by Section 264313.

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2.2 OVERCURRENT PROTECTIVE DEVICES:

A. GENERAL: Provide overcurrent protective devices complying with Division-26 section "Overcurrent Protective Devices", and as indicated on drawings.

2.3 METERING:

A. METER SOCKETS: Provide meter sockets that comply with requirements of local utility company supplying electrical power to service-entrance equipment of building project.

B. METERS: Provide meters, current and potential transformers, selector switches, wiring, etc. for a complete metering system. Provide meter of same manufacturer as switchboard (equal to Square D Power Logic Circuit Monitor, Class 3020, Model CM-3250), integrally mounted in service equipment, completely wired with control power input. Provide capability for metering the following data:

INSTANTANEOUS READINGS	DEMAND READINGS
RMS Current Values	Current Values
Phase A Current	Average Demand Current Phase A
Phase B Current	Average Demand Current Phase B
Phase C Current	Average Demand current Phase C
3-Phase Average Current	Peak Demand Current Phase A
Apparent RMS Current	Peak Demand Current Phase B
RMS Voltage Values	Peak Demand Current Phase C
Phase A-B Voltage	Real Power Values
Phase B-C Voltage	Average Demand Real Power
Phase C-A Voltage	Predicted Demand Real Power
Phase A-N Voltage	Peak Demand Real Power
Phase B-N Voltage	Phase C-N Voltage
Power Factor Values	Energy Readings
Phase A Power Factor	-
Phase B Power Factor	Energy Accumulated
Phase C Power Factor	Reactive Energy Accumulated
3-Phase Total Power Factor	-
3-Phase Total Power Values	-
Real Power, 3-Phase Total	-
Reactive Power, 3-Phase Total	-
Apparent Power, 3-Phase Total	-
Frequency	-
Temperature	-

C. Provide with integral display, selection keys, and indicting LEDs. For each instantaneous reading, provide a running maximum and minimum history in non-volatile memory, capable of externally operated reset. Provide "waveform capture" feature to allow subsequent analysis of actual current and voltage profile for harmonic distortion.

2.4 RACEWAYS AND CONDUCTORS:

A. GENERAL: Provide raceways and conductors complying with applicable Division-26 Basic Materials and Methods sections.

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B. WALL AND FLOOR SEALS: Provide wall and floor seals complying with Division-26 Basic Materials and Methods section "Raceways".

C. Fluidized thermal backfill (FTB): Provide fluidized thermal backfill (FTB) around service lateral conduits (Service Lateral: Conductors/conduits between RMP transformer and meter. See NEC Article 230) when there are seven or more conduits specified. FTB shall comply with requirements of RMP Electrical Service Requirements.

PART 3 – EXECUTION

3.1 INSTALLATION OF SERVICE-ENTRANCE EQUIPMENT:

A. Install service-entrance equipment as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that service-entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC and NEMA standards.

B. Coordinate with other work, including utility company wiring, as necessary to interface installation of service-entrance equipment work with other work.

C. Install all floor standing service equipment on 4" high concrete curb and bolt equipment to curb with 3/8" anchors at each corner and at intervals not to exceed 8' along perimeter. Install concrete wiring trench under floor standing equipment; 12" deep, and 4" smaller in length and width than equipment base. Install grounding bushings on conduits penetrating trench.

3.2 GROUNDING:

A. Provide system and equipment grounding and bonding connections for service-entrance equipment and conductors, as required.

3.3 ADJUST AND CLEAN:

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred enclosure surfaces to match original finishes.

3.4 FIELD QUALITY CONTROL:

A. Upon completion of installation of service-entrance equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 26 2713

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SECTION 26 2726

WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

1.2 DESCRIPTION OF WORK:

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems that are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles
2. Switches
3. Timer Switches
4. 0-10V & ELV LED LAMP DIMMERS
5. Cord caps
6. Cord connectors

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA standards as applicable to construction and installation of electrical wiring devices. Provide electrical wiring devices that have been UL listed and labeled.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES:

A. GENERAL:

1. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub No. WD 1.

B. Provide wiring devices (of proper voltage rating) as follows:

	RECEPTACLE	SWITCHES			
MFGR		1-POLE	3-WAY	4-WAY	W-PILOT
Hubbell	BR20XTR	HBL 1221	HBL 1223	HBL 1224	HBL 1221-PL
Bryant		1221	1223	1224	1221-PL

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Pass Seymour	TR63X	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	TWR20-X	1221	1223	1224	
Cooper	TR5362	1221	1273	1224	1221-PL

C. Provide devices in colors selected by Architect. Provide red devices on all emergency circuits.

D. SURGE PROTECTIVE (SPD) RECEPTACLES:

1. Provide SPD receptacles having 4 series parallel 130V MOV's capable of a minimum of 140 joules suppression. Provide units with visual (and audible) surge status indicators to monitor condition of surge circuit; visual indicator to be "on" when power present and suppression circuit is fully functional. (Audible indicator shall sound a "beep" alarm approximately every 30 seconds if suppression circuit has been damaged.) Provide NEMA 5-20R, 20 amp, 125V receptacle of one of the following manufacturers:

	MANUFACTURER	
SPECIFICATION GRADE	HUBBELL	PASS SEYMOUR
Duplex Recept-Visual only	5350	5352 XXXSP
Duplex Recept-Visual/Audible	5352	5362 XXXSP
Single Recept-Visual only	5351	N/A
Duplex Recept-Isol Gnd, Visual/Audible	IG5352S	IG5362 XXXSP
Single Recept-Isol Gnd, Visual only	IG5351S	N/A
HOSPITAL GRADE	HUBBELL	PASS SEYMOUR
Duplex Recept-Visual/Audible	8300HS	8300 XXXSP
Single Recept-Visual only	8310HS	N/A
Duplex Recept-Isol Gnd, Visual/Audible	IG8300HS	IG8300 XXXSP
Single Recept-Isol Gnd, Visual only	IG8310HS	N/A

2. Color of devices selected by Architect. Provide red devices on all emergency circuits.

E. GROUND-FAULT INTERRUPTER:

1. Provide general-duty, duplex receptacle, ground-fault circuit interrupters; feed-thru types, capable of protecting connected downstream receptacles on single circuit; grounding type UL-rated Class A, Group A, 20-amperes rating; 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; color as selected by Architect. Provide Hospital grade where required elsewhere by specification or drawings. Provide units of one of the following:

a. P&S/Sierra

b. Hubbell

c. Leviton

d. Square D

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F. USB RECEPTACLE

1. Provide duplex receptacle with two (2) USB 3.0 amps, 5VDC, 2.0 Type A charging ports.

2. Provide products of one of the following:

   a. Bryant – USB20-X
   b. Cooper – TR7736-X
   c. Hubbell – USB20X2-X
   d. Legrand – TR5362USB-X
   e. Leviton – T5832-X

G. TAMPER RESISTANT RECEPTACLES:

1. Provide tamper resistant receptacles throughout the entire project and as required per NEC.

2. Provide products of one of the following:

   a. Leviton-TWR20-X
   b. Hubbell – BR20XTR
   c. Pass Seymour – TR63X
   d. Cooper – TR5362

H. WEATHER-RESISTANT RECEPTACLES

1. Provide weather-resistant receptacles in outdoor locations such as under roofed open porches, canopies, marquees, etc.

2. Provide products of one of the following:

   a. Pass & Seymour 2095TRWRXXX.
   b. Hubbell GFTR20XX

I. CORD CAPS AND CONNECTORS:

1. Provide 3, 4 and 5-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment, and as indicated otherwise on drawings.

2. Provide products of one of the following:

   a. Cooper
   b. General Electric
   c. Hubbell
   d. Leviton
   e. P&S

J. TIMER SWITCH:

1. Provide a timer switch with the following features and functionalities. Provide switch that mounts in a standard wall box. Provide a Decora style cover plate that matches the other switches on the project. Provide color of switch chosen by Architect.

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a. Provide Digital time switches that automatically turn lights off after a preset time. User programmable wall switch for astronomical and scheduled control. Electroluminescent back-lit LCD shows timer countdown. Compatible with all electronic ballasts, ELV, MLV, LED, and motor loads.

i. Wattstopper TS-400: 120/277VAC; 50/60 Hz

ii. Greengate

b. Provide Astronomical time switches that automatically turns lighting or other loads on and off according to user programming. Time-out settings range shall range from 5 minutes to 12 hours for flexibility. Electroluminescent back-lit LCD shows timer countdown. Compatible with all electronic ballasts, ELV, MLV, LED, and motor loads. Program schedule per the owner's requirements.

i. Wattstopper RT-200: 120/277VAC; 50/60 Hz

K. 0-10V & ELV LED LAMP DIMMERS:

1. Provide single-pole, semi-conductor modular type 0-10V control for 0-10V fluorescent ballasts/LED drivers & 3-wire fluorescent ballast/LED driver dimmers for fixtures; 60 hertz, with wattage and voltage as indicated, continuously adjustable slider control, and with electromagnetic filters to reduce noise and interference to minimum. Construct with continuously adjustable trim potentiometer for adjustment of low end dimming. Dimmer shall match lamp/ballast combination. Color as selected by Architect. Provide devices manufactured by one of the following:

a. Pass & Seymour (Titan Series)

b. Lutron (Nova Series)

c. Lutron (Diva Series)

2.2 WIRING DEVICE ACCESSORIES:

A. WALL PLATES:

1. Provide stainless steel cover plates in all finished areas. Provide galvanized steel plates in unfinished areas. Provide blank coverplates for all empty outlet boxes.

B. WEATHER-PROTECTING DEVICE ENCLOSURES:

1. Where required for compliance with NEC 406-8 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers that provide complete protection with the cord and cap inserted into the wiring device. Provide units that mount on either single or double gang devices.

2. Provide products of one of the following extra-duty low-profile expandable in-use weatherproof covers for exterior mounted installations:

a. Intermatic:

i.	WP7000W	Single-Gang/White Cover
ii.	WP7000G	Single-Gang/Gray Cover
iii.	WP7000BR	Single-Gang/Brown Cover
iv.	WP7200W	Double-Gang/White Cover

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v. WP7200G Double-Gang/Gray Cover

vi. WP7200BR Double-Gang/Brown Cover

b. TayMac:

i. ML500W Single-Gang/White Cover

ii. ML500G Single-Gang/Gray Cover

iii. ML500Z Double-Gang/Brown Cover

iv. ML2500G Single-Gang/Gray Cover

c. Color chosen by architect.

3. Provide products of one of the following for roof mounted installations:

a. Intermatic WP1020 or WP1030

b. P&S WIUC10C or WIUC20c

PART 3 – EXECUTION

3.1 GENERAL

A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices, equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings before beginning rough-in of electrical work. Adjust locations of all electrical outlets as required to accommodate work in area, and to avoid conflicts with wainscoat, back splash, tackboards, and other items.

C. Where stranded conductors have been utilized, provide solid pigtails to terminate at device.

D. Provide receptacles in surface raceway at 12” on center unless indicated otherwise.

E. Install wiring devices only in electrical boxes that are clean; free from excess building materials, dirt, and debris.

F. Install blank plates on all boxes without devices.

G. Delay installation of wiring devices until wiring work and painting is completed. Provide separate neutral conductor from panel to each GFI receptacle.

H. Install GFI receptacles for all receptacles installed in the following locations:

1. Restrooms, locker rooms, kitchens, within 6 feet of any sink, or when serving vending machines and electric drinking fountains.

2. Indoor wet locations, non-dwelling garages, elevator rooms and pits.

3. Outdoors, and on rooftops.

4. Dwelling unit garages, crawlspaces and unfinished basements, accessory buildings, boathouses, and receptacles for boat hoists.

5. Label all receptacles (non-GFI), protected downstream of a GFI receptacle or

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protected by GFI circuit breaker, with an indication that it is protected.

I. Where light switches or wall box dimmers are specified, provide a separate neutral for each phase of the branch circuits that switches or dimmers are connected.

J. Electrical Identification: Refer to Section 260553 for requirements.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES:

A. At time of substantial completion, replace those items, that have been damaged, including those stained, burned and scored.

3.3 GROUNDING:

A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated.

3.4 TESTING:

A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 26 2726

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SECTION 26 2815

OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of overcurrent protective device work is indicated by drawings and schedules and specified herein. Overcurrent protective devices specified herein are for installation as individual components in separate enclosures; and for installation as integral components of switchboard and panelboards. See Section 262413, Switchgear and Switchboards, and Section 262416, Panelboards.

B. Types of overcurrent protective devices in this section include the following for operation at 600 Volts and below:

1. Molded case thermal circuit breakers
2. Molded case solid-state circuit breakers
3. Insulated case circuit breakers
4. Power circuit breakers
5. Fuses

C. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices.

1.3 QUALITY ASSURANCE:

A. Comply with NEC requirements and NEMA and ANSI standards as applicable to construction and installation of overcurrent devices.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products of one of the following (main and branch device manufacturer must be same as panelboard and/or switchboard manufacturer):

B. CIRCUIT BREAKERS AND FUSIBLE SWITCHES:

1. Cutler Hammer Products, Eaton Corp.
2. General Electric Co.
3. Square D Co.

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4. Siemens Energy and Automation

C. MOLDED CASE THERMAL TRIP CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breaker for power distribution panelboards and switchboards; and for individual mounting, as indicated. Provide breakers of amperage, voltage, and RMS interrupting rating shown, with permanent thermal trip and adjustable instantaneous magnetic trip in each pole. Series rated systems are not acceptable. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with mechanical screw type removable connector lugs, AL/CU rated, of proper size to accommodate conductors specified.

2. Circuit breakers 15 amps through 399 amps shall be molded case thermal trip circuit breakers.

D. MOLDED CASE SOLID-STATE CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case solid-state circuit breakers for power distribution switchgear and switchboards. Provide breakers of amperage, voltage and RMS interrupting rating shown, and with solid-state trip mechanisms. Breakers shall be UL listed for application at 100% of their continuous ampere rating.

2. Circuit breakers 400 amps through 1199 amps shall be molded case solid-state circuit breakers.

3. Solid-state trip mechanisms shall have the following functions: Adjustable long time ampere rating; adjustable long time delay; adjustable short time pick up; adjustable short time delay and adjustable instantaneous pick up.

E. INSULATED CASE CIRCUIT BREAKERS

1. Provide factory-assembled, insulated case circuit breakers for power distribution switchgear and switchboards. Provide breakers of amperage, voltage and RMS interrupting rating shown, with solid-state trip mechanisms and with manual spring charging mechanism. Breakers shall be UL listed for application at 100% of their continuous ampere rating.

2. Circuit breakers 1200 amps and larger shall be insulated case circuit breakers.

3. Solid-state trip mechanisms shall have the following functions: Adjustable long time ampere rating; adjustable long time delay; adjustable short time pick up; adjustable short time delay and adjustable instantaneous pick up.

4. On service disconnect breakers where phase to ground voltage exceeds 150V and the breaker is capable of being set at or over 1000A (and also where GFP protection is indicated on the one line diagram for downstream breakers), the solid-state trip mechanism shall also include the following:

   a. Adjustable ground fault pick up and adjustable ground fault time delay, and ground fault test button.

   b. Over/under voltage trip

   c. Current imbalance trip

5. Provide an energy-reducing maintenance switch with local, lit status indicator to allow for a reduction of the instantaneous pickup and instantaneous delay settings for use during maintenance. Device shall mount in face of dead-front. The switch shall be provided by the same manufacturer as the circuit breaker.

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6. Include integral phase failure (single-phasing) protection where phase failure (PF) is indicated on the one line diagram

F. GROUND FAULT PROTECTION:

1. Provide ground fault sensing and relaying equipment on all overcurrent protective devices where phase to ground voltage is in excess of 150 volts and the overcurrent protection device is capable of being set at or over 1000 amps. Provide ground fault sensing and relaying equipment on other devices as indicated.
2. Provide zero sequence current sensors for overcurrent protective devices; inputs compatible with relay. Construct sensor frame so it can be opened to prevent removal or installation around conductors without disturbing conductors. Provide test winding in sensor for testing operation of GFP unit including sensor pick-up relay, and circuit protection device operation.
3. Provide solid-state ground-fault relay, that requires no external source of electrical power, drawing energy to operate GFP system directly from output of current sensor. Construct with adjustable pick-up current sensitivity for GF current from 200 to 1200 amperes, with calibrated dial to show pick-up point settings. Provide factory-set time delay of 1.5 seconds and protection that precludes tampering with setting after installation.
4. Provide monitor panel capable of indicating relay operation, and provide means for testing system with or without interruption of service. Construct so GF system can not be left in an inactive or OFF state. Provide indicator lamps and TEST and RESET control switches.
5. MANUFACTURER: Subject to compliance with requirements, provide ground-fault sensing and relaying equipment of one of the following:
    a. General Electric Co.
    b. Brown Boveri Electric, Inc.
    c. HI-Z Corporation
    d. Pringle Electric Mfg. Co.
    e. Square D Co.

2.2 FUSES:

A. GENERAL: Except as otherwise indicated, provided fuses of type, sizes and ratings and electrical characteristics of a single manufacturer as follows. Provide fuses labeled UL Class L or UL Class R, current limiting and rated for up to 200,000 amperes. Provide Buss KAZ signal activating fuses where required elsewhere in specification.

B. Where fuses are shown feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing; adjust fuse size and type as necessary to comply with manufacturer's recommendation.

C. Provide and install spare fuse cabinet in main electrical room.

D. MAIN SERVICE AND FEEDER CIRCUITS: For fuse ratings over 600 amperes provide UL Class L Fuses (KRP-C, or A4BQ or LCL or KLPC). For fuse ratings up to 600 amperes, provide UL Class RK1 (KTN-R, KTS-R or A2K-R, A6K-R or NCCR, SCLR or KLN-R, KLS-R). If fuse directly feeds motors, transformers or other inductive load provide UL RK5 time delay (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECS-R or FLN-R, FLS-R).

E. BRANCH CIRCUITS: For motor circuits, transformer circuits, or other inductive loads, provide UL Class RK5 (FRN-R, FRS-R or TR-R, TRS-R or ECN-R, ECN-S or FLN-R, FLS-A). For other circuits, provide UL Class RK1, (KTN-R, KTS-R OR A2K-R, A6K-R or NCLR, SCLR OR KLNR, KLSR).

F. MANUFACTURER: Subject to compliance with requirements, provide fuses of one of the following:

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1. Bussman Mfg. Co.
2. Mersen (Ferraz Shawmut)
3. Reliance Fuse Div./Brush Fuse Inc.
4. Littlefuse, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES:

A. Install overcurrent protective devices as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with work as necessary to interface installations of overcurrent protective devices with other work.

C. Install fuses in overcurrent protective devices. For motor circuits, fuse sizes shown on drawings are for general guidance only. Size fuses in accordance with fuse manufacturer's recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) as required to provide nuisance free tripping. Adjust fuse size properly for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times. Include all costs in bid.

D. After the switchgear is energized and just prior to Substantial Completion, the contractor shall ensure that the field-adjustable circuit breakers and solid-state circuit breakers and associated trip mechanisms have been set to the appropriate settings as recommended by the equipment Manufacturer (or as recommended by the electrical contractor's Protective Device Study if section 260573 has been included in the project). Time-current trip curves and trip setting information as was required in the Submittal portion of this specification shall be made available by the contractor at this time. Provide adjustments to circuit breakers and switchboard AIC ratings as deemed necessary by the analysis/report, with no additional cost to the Owner. Provide over current protection devices with larger frame sizes to ensure coordination has been achieved.

E. Field test all ground fault protective devices for proper operation; test to be performed by representative of the manufacturer. Include verification of complete time current trip characteristics.

F. Electrical Identification: Refer to Section 260553 for requirements.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 26 2815

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SECTION 26 2816

MOTOR AND CIRCUIT DISCONNECTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to motor and circuit disconnect switches specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedule. Work includes complete installations and electrical connections.

1.3 QUALITY ASSURANCE:

A. Provide motor and circuit disconnect switches that have been UL listed and labeled. Comply with applicable requirements of NEMA Standards Pub. No. KS 1, and NEC.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. MANUFACTURER: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

1. Cutler Hammer Products, Eaton Corp.
2. Square D Company
3. General Electric Company
4. Siemens Energy & Automation, Inc.
5. Cooper Bussmann

2.2 FABRICATED SWITCHES:

A. GENERAL: Provide disconnect and safety switches as indicated herein. Provide:

1. General duty switches on 240 Volt rated circuits.
2. Heavy duty switches on 480 volt rated circuits.
3. HP rated switches on all motor circuits.

B. GENERAL DUTY SWITCHES: Provide general-duty type, sheet-steel enclosed switches, fusible or non-fusible as indicated of types, sizes and electrical characteristics indicated; rated 240 volts, 60 hertz; incorporating spring assisted, quick-make, quick-break mechanisms. Provide single phase or three phase and with solid neutral as required by application. Equip with operating handle that is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application, unless noted. Provide

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fusible switches with Class R rejection fuse clip kits.

C. HEAVY-DUTY SWITCHES: Provide heavy-duty type, sheet-steel enclosed safety switches, fusible or non-fusible as indicated, of types, sizes and electrical characteristics indicated; rated 600 volts, 60 hertz; incorporating quick-make, quick-break type mechanisms. Provide single phase or 3 phase, and with solid neutral as required by application, Equip with operating handle that is capable of being padlocked in OFF position. Provide NEMA 1 or NEMA 3R as required by application unless noted. Provide fusible switches with Class R rejection fuse clip kits.

D. FUSES: Provide fuses for switches, as required of classes, types and ratings needed to fulfill electrical requirements for service indicated. Provide spare fuses amounting to one spare fuse for each 10 installed but not less than three of any one type and size. See Section 262815 Overcurrent Protective Devices for fuse types.

E. Electrical Identification: Refer to Section 260553 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES:

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches used with motor driven appliances, and motors and controllers within sight of controller position.

D. For disconnect switches serving motors controlled by variable frequency drives, provide late-make, early-break auxiliary contacts on each disconnect switch. Provide Heavy-Duty switch. Wire auxiliary contact to VFD safety contact, such that disconnecting the motor will shut down the drive first, and closing the switch will start the drive only after power is applied to the motor.

E. For all disconnect switches serving single elevator applications, provide a Cooper Bussman Quik-Spec™ Power Module™ Switch.

1. Elevator Shutdown
2. Shunt Trip Voltage Monitoring
3. Selective Coordination
4. Fire safety signal interface
5. Auxiliary Contact (Hydraulic Elevator)
    a. Wire auxiliary contact to auxiliary power such that disconnecting the motor will disconnect the auxiliary power.

END OF SECTION 26 2816

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SECTION 26 2913

MOTOR STARTERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Materials and Methods section, and is part of Division-26 sections making reference to motor starters specified herein.

1.2 DESCRIPTION OF WORK:

A. Extent of motor starter work is indicated by drawings and schedules.

B. Types of motor starters in this section include the following:

1. AC Fraction Horsepower Manual Starters
2. AC Line Voltage Manual Starters
3. AC Non-Reversing Magnetic Starters
4. AC Combination Non-Reversing Magnetic Starters

1.3 QUALITY ASSURANCE:

A. Comply with NEC and NEMA Standards as applicable to wiring methods, construction and installation of motor starters. Comply with applicable requirements of UL 508, "Electric Industrial Control Equipment", pertaining to electrical motor starters. Provide units that have been UL-listed and labeled.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):

1. Allen-Bradley Co.
2. Appleton Electric Co.
3. Crouse-Hinds Co.
4. Eaton Corp., Cutler Hammer Products
5. General Electric Co.
6. Siemens Energy & Automation, Inc.
7. Square D Co.

B. MAINTENANCE STOCK, FUSES: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 5 units of each, for both power and control circuit fuses.

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2.2 MOTOR STARTERS:

A. GENERAL: Except as otherwise indicated, provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated that comply with manufacturer's standard materials, design and construction in accordance with published information and as required for complete installations.

B. THERMAL OVERLOAD UNITS: Provide thermal overload units, sized to actual running full load current, not to motor plate current. Size heaters for mechanical equipment after air and water balancing have been completed.

C. AC FRACTIONAL HP MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide manual, single-phase, 1 and 2 pole, 300 volt AC max, fractional HP motor starters, of types, ratings and electrical characteristics indicated; equip with one piece thermal overload relay with field adjustment capability of plus or minus 10 percent of nominal overload heater rating; for protection of AC motors of 1 HP and less. (For manually controlled motors in excess of 1 HP, see Line Voltage Manual Starters specified herein). Provide starter with quick-make, quick-break trip free toggle mechanisms, green pilot lights, and with lock-off toggle operated handle. Mount surface units in NEMA 1 enclosures, unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location unless noted otherwise. Provide flush mounted units with coverplate to match wiring device coverplates.

D. AC LINE VOLTAGE MANUAL STARTERS (EQUAL TO SQUARE D CLASS 2510): Provide line voltage manual starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt AC max; equip with pushbutton operator, low voltage protection feature, and green pilot light. Provide starters with trip free mechanism such that contacts will open under load and remain open until thermal element has cooled, and unit is reset. Mount surface units in NEMA 1 enclosure, unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location, unless noted otherwise. Provide overlapping trim for flush mounted units.

E. AC NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8536): Provide line voltage magnetic starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volt max, with thermal overload protection in all phases and inherent under voltage release. Equip units with holding contact, 2 normally open, and 2 normally closed auxiliary contacts, unless noted otherwise. Provide fused control transformer in each starter and 120V control coil. Mount hand-off-auto switch, red pilot light, and reset button in face of enclosure. Provide NEMA 1 enclosure unless noted otherwise. Provide NEMA 3R enclosure in exterior or damp location, unless noted otherwise. Equip all spare starters complete with items as specified herein.

F. AC COMBINATION NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8539): Provide line voltage combination starters, of types, ratings and electrical characteristics indicated; 2 or 3 pole, 600 volts max with non-reversing magnetic starters as specified herein; in common cubicle or enclosure with motor circuit protector. Provide motor circuit protector, instantaneous trip circuit breaker as indicated and adjust to comply with manufacturer's recommendations. Mount hand-off-auto switch, red pilot light, and reset button in face of enclosure. Provide combination starters for individual mounting, or for group mounting in motor control center as indicated. Provide NEMA 3R enclosure in exterior or damp locations, unless noted otherwise. Provide NEMA 1 enclosures unless otherwise indicated.

G. AC COMBINATION NON-REVERSING MAGNETIC STARTERS (EQUAL TO SQUARE D CLASS 8538): Provide line voltage combination starters, of types, ratings, and electrical characteristics; 2 or 3 pole, 600 volt maximum with non-reversing magnetic starters as specified herein; in common cubicle or enclosure with fusible disconnect switch. Provide quick-make, quick-break, disconnect for NEMA sizes 1, 2, 3, and 4; and visible blade, automatic circuit interrupters with push-to-trip feature and separate fuse clips for larger NEMA sizes. Fuse all starters with dual-element (time-delay) fuses equal

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to Bussman FRN/FRS-R. Equip disconnect switch with Class R rejection fuse kits. Mount hand-off-auto switch, red pilot light, and reset button in face of enclosure. Provide combination starters for individual mounting, or for group mounting in motor control centers as indicated. Provide NEMA 1 enclosures unless otherwise indicated. Provide NEMA 3R enclosure in exterior or damp locations, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS:

A. Install motor starters as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Install fuses in fusible disconnects, if any. Mount chart inside each starter indicating heater type, size, and ampere ratings available.

C. Electrical Identification: Refer to Section 260553 for requirements.

3.2 ADJUST AND CLEAN:

A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL:

A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 26 2913

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SECTION 26 2923

VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Provide variable frequency drive (VFD) and VFD systems work as indicated by drawings, schedules and as specified herein. Work includes complete installation, electrical connections, testing, and commissioning.

B. Verify compatibility of VFD with motors supplied under Division 23. Review Division 23 specifications, plans, schedules, etc., to ensure compatibility.

C. Provide harmonic control for all VFD systems. Provide AC line reactors for VFD systems serving motors less than 10 HP. Provide harmonic filters for VFD systems serving motors 10 HP and larger. Refer to paragraph 1.4.B.5 in the submittals portion of this specification for harmonic distortion limits.

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and IEEE (including Harmonic Standard IEEE-519) Standards as applicable to wiring methods, construction and installation of variable frequency drives. Comply with applicable requirements of UL 508, "Power Conversion Equipment". Provide complete packaged units that have been UL-listed and labeled by Underwriters Laboratory or ETL Testing Laboratories, Inc. Note: The entire unit shall carry the label, not just components.

1.4 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. GENERAL: Subject to compliance with requirements, provide products manufactured by and supplied by one of the following vendors:

	VENDOR	VFD MANUFACTURER
1.	Energy Management Corporation	Mitsubishi
2.	Codale Electric Supply	Allen Bradley
3.	GE	GE/ABB

B. VENDOR REQUIREMENTS: Vendors requesting approval by addendum must meet the following minimum requirements.

1. Must be actively engaged in manufacturing and supplying pulse width modulated variable frequency drives and built up systems, and must have a minimum of five years of experience in each supply or manufacture, as applicable.

2. Must maintain full time service personal on call 24 hours/day as well as authorized parts and service facilities within 250 miles of the project with demonstrated record of service for at least the last three years.

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3. Must have UL 508C or ETL certification if project requires "built-up" assemblies that are not "factory-standard" products.
4. Must be an ISO-9001 certified facility; manufacturing all products to ISO-9001 quality standards.

2.2 GENERAL:

A. Except as otherwise indicated, provide pulse width modulated variable frequency A.C. drives and ancillary components; of types, sizes, ratings and electrical characteristics indicated that comply with manufacturer's standard materials, design and construction in accordance with published information and as required for a complete installation.

2.3 APPLICATION:

A. Provide drive units that are applicable to the driven load characteristics. For centrifugal fan and pump applications, provide variable torque rated VFD's capable of providing 115% rated current for one minute. For conveyor, positive displacement pump and compressor applications, provide constant torque rated VFD's capable of providing 150% of rated current for one minute. In addition, provide drives that meet the following operating conditions:

1. Operable on facility power, with voltage and phase provided at building site, and without the need for isolation or step up/down transformers unless indicated.
2. Capable of performing at an altitude of 4500 feet above sea level and have an operating temperature range 0° to 40°C (32° to 104°F) with a relative humidity of 0 to 90% (non-condensing). If mounted outdoors or in unconditioned spaces, provide environmental control necessary to operate in climate of -20°C to 50°C (-4° to 122°F), 0 to 100% R.H.

2.4 VARIABLE FREQUENCY DRIVE SYSTEM:

A. The variable frequency AC drive shall convert 3 phase, 60 Hertz input power to an adjustable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The rectifier section (converter) shall employ a diode or fully gated bridge to develop a constant DC bus voltage. Variable voltage rectifiers utilizing partially gated SCR's are unacceptable. The DC bus shall utilize filter capacitors and DC link inductors to minimize generated harmonics. The PWM inverter control scheme shall produce an output wave form that closely approximates actual sine wave current. The output voltage shall vary proportionally with the output frequency to maintain a constant volts/hertz value up to 60 Hz. The output voltage will remain constant above 60 Hz. The continuous current rating shall be equal to or greater than the full load amperes required by the application. Provide units capable of starting and continuously driving the specified maximum motor load as identified on drawings and schedules. Provide units with input filters and line reactors.

B. Provide system capable of operating without any system trip or damage based on the nominal power specifications and requirements indicated and subject to the following fluctuation:

1. Plus or minus 10% voltage fluctuation.
2. Plus or minus 3% frequency variation (5% if served by back-up generator)
3. Distorted voltage waveform with up to 10% total voltage harmonic distortion.

C. Provide system with voltage sag ride-through coordination under normal operating (average load) conditions to prevent nuisance trips with the following utility interruptions (based on preliminary IEEE working group P1346 data):

1. 0% voltage for 1 cycle.
2. 60% voltage for 10 cycles.

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3. 87% voltage continuous.

D. The drive shall have sufficient capacity to provide speed control of the motor throughout the operating range as specified herein.

E. The Drive shall have BACnet protocol capability.

2.5 EFFICIENCY AND POWER FACTOR:

A. Provide solid state converter and inverter power switching components and controls to achieve a minimum 95% efficiency at full load and speed.

B. The displacement power factor (as measured at the input to the VFD system) shall be 95% or better across the operational speed range.

2.6 PROTECTION:

A. Provide short circuit protection by means of an externally operated, door interlocked circuit breaker or motor circuit protector (MCP) rated at 65,000 AIC minimum. Provide VFD's with fast acting semi-conductor fuses to protect against input short circuits. The door interlocked handle must be capable of being locked off to meet NEC requirements.

B. Provide VFD operated motor overload protection by means of programmable, speed sensitive, electronic overload circuits with instantaneous trip, inverse time trip and current limit functions. These shall be adjustable and optimized for the application. Comply with NEC requirements and UL 991. In the by-pass mode provide motor overload relay set to protect the motor and capable of starting across the line.

C. In addition to the protection above, provide over- and under-voltage protection, over-temperature protection, ground fault protection, and control or microprocessor fault protection. These protective circuits shall cause an orderly shutdown of the VFD, provide indication of the fault condition, and require a manual reset (except undervoltage) before restart. Undervoltage from a power loss shall be set to automatically restart after return to normal. The history of the previous three faults shall be retained in a fault buffer for later review.

2.7 CONSTRUCTION:

A. Provide NEMA configuration enclosure for each variable frequency drive system. The enclosure shall be either wall mounted or free standing, as required, with forced ventilation. Mount all components in a single enclosure including, but not limited to, the VFD unit, contactors, door interlocked circuit breaker, bypass/isolating equipment, and/or other items listed in the specification or shown on the drawings. All components shall be completely wired within the enclosure. Systems requiring mounting and interwiring of separate bypass enclosure are not acceptable. Limit overall size of unit to space allocated on the drawings. Verify code required clearance requirements before manufacture and installation of unit.

B. Indoor location: Provide NEMA 12 dust tight, non-ventilated enclosure, or NEMA 1 ventilated enclosure, ventilated by means of filtered air forced through the enclosure to create a positive internal pressure.

C. Outdoor location or location exposed to weather: Provide NEMA 4 (wash down type), non-ventilated, enclosure. Locate all external heat sinks, fans, etc. associated with heat transfer in the rear of the enclosure with adequate stand offs for proper convection.

D. Mount the variable frequency drive ancillary components on a removable panel within the enclosure such that panel is removable from enclosure for maintenance and part replacement.

E. Provide "Machine Tool" type control transformer with primary and secondary fusing. All control power for operator devices and customer connections shall be 120 volts.

F. Mount door with a minimum of two hinges with removable pins. Door shall be rigid and

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large doors shall have additional hinges and stiffening steel.

G. Provide door mounted, industrial type, oil tight operator devices similar to those found on motor control centers.

H. Paint enclosure with high grade epoxy (ANSI 61 Grey), a minimum of 50-70 microns thick.

I. Provide an electrical shock warning label to warn personnel that a potential of electric shock exists.

J. Provide screened or engraved labels on all door operator and pilot devices.

2.8 STANDARD FEATURES:

A. Provide the following standard features on all VFD units:

1. Motor Braking Torque shall be accomplished by means of DC injection into the motor or by regenerative braking.
2. The drive shall contain an output frequency clamp such that minimum or maximum output frequency can be set at desired limits.
3. Frequency Jump: The drive shall be supplied with frequency jump control to avoid operating at a point of resonance with the natural frequency of the machine.
4. Synchronous Transfer: Provide synchronous transfer feature to allow transfer of motor from VFD to the utility line and back to VFD operation while the motor is running.

B. Provide the following door mounted operator controls as a minimum:

1. Hand/Off/Auto switch
2. VFD/Bypass selector switch
3. Local/Remote speed control
4. Frequency setting speed pot
5. Frequency indication meter calibrated in % speed.
6. Motor voltage indication
7. Motor current indication
8. VFD enable light
9. VFD fault light
10. VFD in Bypass light
11. External fault light (safeties interlock). If drive has an English character based display, this indication can be shown on that display in lieu of a pilot light.

C. Provide a minimum of the following protective features with an alarm display indication:

1. Instantaneous overcurrent
2. Motor stalled
3. Motor overload
4. Heatsink over temperature
5. Power loss
6. Output ground fault
7. Output short circuit
8. Loss of process speed signal (i.e. 4-20 ma.)
9. Microprocessor malfunction

D. Provide the following termination points on a terminal strip for field connection:

1. Safeties interlock connection

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2. Remote Start/Stop connection
3. Remote VFD fault connection
4. Remote VFD/Bypass enable connection
5. Remote speed reference signal input (See item G below)

E. Provide the following parameter adjustments to tune the VFD system:

1. Minimum and maximum speeds; maximum output voltage at output frequency
2. Acceleration and deceleration times (adjustable from 1 to 120 seconds, minimum)
3. Overcurrent trip point
4. Current limit response to overload
5. Adjustable carrier frequency to minimize audible motor noise.
6. DC boost to automatically (or manually, 3%) adjust boost voltage on each start to compensate for load changes.

F. The VFD shall be capable of starting into a rotating motor at any speed.

G. Remote signal connection terminals (0-5 VDC or 0-10 VDC = 0-100% speed or 4-20 ma = 20-100% Speed). Analog signals shall be programmable as normal or inverted.

H. The VFD shall have a programmable response to loss of a 4-20 ma signal. The following responses are acceptable.

1. Fault and stop the drive
2. Alarm and maintain last reference (within 10%)
3. Alarm and go to preset speed
4. Alarm and go to minimum speed
5. Alarm and go to maximum speed

I. The VFD shall have a programmable analog output rated either 0-20 ma or 0-5 volts to represent one of the following:

1. Proportional to output frequency
2. Proportional to output current
3. Proportional to DC bus voltage
4. Proportional to output power
5. A programmable output offset shall be provided to allow modification of the analog output to obtain 2-10 volt DC or 4-20 ma.

J. The VFD shall have output relay contacts rated 115 volt AC/30 volt DC 5 amp resistive, 2 amp inductive. The contacts shall be:

1. Form A run contact
2. Form C fault contact
3. Form C alarm contact
4. Form A programmable contact to change state upon the following conditions: at speed, at frequency, at current, or at torque

K. Main Disconnect: Provide a main disconnect MCP to disconnect the VFD system from incoming power.

L. Bypass/Isolation: Provide a contactor arrangement for manual bypass and isolation.

1. Provide bypass contactor arrangement for transfer of the motor load to the incoming power for operation at constant speed.

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2. Provide isolation contactor arrangement to disconnect the VFD output from the motor and disconnect the VFD input and harmonic controls from incoming power to allow maintenance on the VFD while operating in the bypass mode.
3. The bypass and isolation contactors shall be electrically and mechanically interlocked. Operation of the VFD/Bypass selector switch to the bypass mode shall disconnect the VFD and allow the motor to operate in the bypass mode.
4. Provide adjustable motor overload relays on the load (output) side of the VFD system.
5. All components shall be pre-wired in the same enclosure, and shall include the VFD, harmonic controls, contactors, main disconnect MCP, motor overload relays, VFD/Bypass selector switch, and VFD in Bypass light.

M. Harmonic Controls: Provide AC line reactors and/or harmonic filters as required to meet the harmonic distortion requirements specified in Submittals paragraph 1.4.B.5 of this specification.

N. Provide VFD with transient voltage surge suppression with maximum UL 1449 suppression rating of 1000 volts, line to ground on 480 volt systems, and 500 volts, line to ground on 208 volt systems.

2.9 ADDITIONAL FEATURES:

A. The following additional features shall be provided:

1. Digital or analog ammeter.
2. Digital or analog voltmeter.
3. Ammeter/Voltmeter Switch for 3 phase operation.
4. Wattmeter.
5. 3-15 PSI P/E transducer for drive speed control.
6. Controls for manual forward/reverse motor operation.

B. Rated overload current upgraded to 150% for constant torque rated VFD’s and 115% for variable torque rated VFD’s. Hardware overcurrent shall be 225% of VFD’s constant torque rating.

C. Hand-held Programming Unit with 14 function fault indication. The following faults shall be indicated.

1. Overvoltage
2. Power failure
3. Overheat inverter
4. Brake Fault
5. Acceleration Overcurrent
6. Steady Speed Overcurrent
7. Deceleration Overcurrent
8. Overload motor
9. Overload inverter
10. Stall trip
11. Undervoltage
12. Ground Fault
13. External Temp. Trip
14. Option Failure

D. Upgraded adjustable acceleration/deceleration item settings adjustable from 0.1 to 3600

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seconds.

E. Provide terminals for connecting dynamic braking resistors in the event load inertia is such that the required deceleration time generates bus overvoltage faults.

F. Provide several ports for remote control/monitoring of the drive functions.

G. Run/Jog Switch door mounted.

H. Forward/Reverse Switch door mounted.

I. Multi-motor units with overload for each motor.

J. Lead/lag motor control when VFD is operating more than one motor, if applications require.

2.10 TESTING:

A. Prior to shipping, test each unit and provide a certified test report with each unit. Standard tests shall include:

1. Visual inspection: Consisting of checking unit enclosure, wiring, connections, fasteners, covers and locking mechanism.
2. High pot test: Two (2)X rated voltage plus 1000 volts AC for 60 seconds shall be applied per UL 508 on all peripheral drive system power components (circuit breakers, contactors, motor overloads, line reactor, disconnect switches etc.) as a complete package. A copy of test results shall be included in operation manuals.
3. System run test under actual motor load.
4. Control panel devices: test all devices, lights, switches, etc.
5. Additional Equipment: test additional equipment specified with VFD system.
6. Special tests: as required and specified.

2.11 ELECTRICAL IDENTIFICATION:

A. Refer to Section 260553 for requirements.

PART 3 – EXECUTION

3.1 MECHANICAL COORDINATION:

A. Meet with the supplier of the mechanical equipment and determine the exact characteristics of the motors that VFD's are to be provided for. Verify the exact control requirements, including interface signal type, reversing/non-reversing drives, interlocks, etc.

3.2 INSTALLATION OF VARIABLE FREQUENCY DRIVES:

A. Install variable frequency drives as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards, and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

3.3 MOTOR DISCONNECT INTERLOCK:

A. Where motor disconnect switches are installed on the load side of VFD's, provide late-make, early-break auxiliary contacts on each disconnect switch. Wire auxiliary contact to VFD safety contact, such that disconnecting the motor will shut down the drive first, and closing the switch will start the drive only after power is applied to the motor.

3.4 ADJUST AND CLEAN:

A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for

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free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.5 START-UP SERVICES:

A. The supplier of the AC drive described herein, shall provide field start-up service by an authorized factory trained service representative. The factory representative shall be trained in the maintenance and troubleshooting of the equipment as specified herein. Start-up service shall include system check-out, start-up and system run, and harmonic testing.

1. Verify that the input voltage is within the manufacturer's specification tolerances.
2. Verify that the motor rotation is correct in all modes of operation.
3. Verify all operator devices, programming and monitoring functions to be fully operational.
4. Verify operation of all field signal control connections.
5. Measure and record system output voltage and current at 50% and 100% speed. Tune the output voltage to correspond to motor nameplate data.
6. Make all parameter adjustments to tune and optimize the VFD system to the application. Record all configuration values as part of this report.
7. Conduct harmonic tests as identified below.

B. Provide owner training for each model and type of VFD system provided.

3.6 HARMONIC DISTORTION REPORT:

A. After installation is complete, measure the harmonic voltage and current distortion of each Variable Frequency Drive system, with the VFD unit running at 50% operating speed and at highest operating speed. Take measurements on each phase (L-L and L-N) on the line side (input terminals) of the VFD.

B. Submit report that includes the following:

1. Data (text and graphical) showing voltage and current waveforms, voltage and current THD and individual harmonic spectrum analysis.
2. Power quality reports including telephone influence factor, true and displacement power factor, and voltage and current imbalance.

C. Prior to final acceptance, provide the engineer with two (2) copies of the harmonic distortion report. If the harmonics exceed the specified limits, VFD system will be rejected. The VFD vendor shall then have thirty (30) days to revise the harmonic control scheme and resubmit new shop drawings and new harmonic verification test reports for final acceptance. All costs resulting from non-compliance rejection, including additional engineer and contractor review time, will be paid by the VFD supplier.

3.7 OPERATION AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

END OF SECTION 26 2923

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SECTION 26 3213

EMERGENCY POWER INVERTER SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of emergency electrical system work is indicated by drawings and schedules. Provide a complete turn-key solution based upon the requirements of the lighting load and a 90-minute emergency run-time for the Field House emergency lighting system.

B. Types of emergency system components specified in this section include the following:

1. Battery Lighting Inverter System

C. CONDUCTORS/CABLES, RACEWAYS, AND ELECTRICAL BOXES AND FITTINGS are specified in applicable Division-26 Basic Materials and Methods sections.

D. Refer to other Division-26 sections as applicable for work required in connection with emergency electrical systems.

1.3 QUALITY ASSURANCE:

A. Comply with NEC as applicable to wiring methods, materials, construction and installation of emergency electrical systems. Comply with applicable requirements of UL 924, "Emergency Lighting and Power Equipment". Provide system components, which are UL-listed and labeled.

B. Comply with applicable requirements of NFPA Nos. 37, (99), 101, and 110 pertaining to life safety code, and emergency and standby power supplies.

1.4 SUBMITTALS:

A. SHOP DRAWINGS: Submit the following:

1. Dimensioned drawings of emergency transfer system components and accessories for a complete system. Show accurately scaled layouts of system components; indicate their spatial relationship to associated equipment; show connections to normal and emergency power feeders. Failure to submit said scaled lay-outs does not relieve contractor of responsibility to verify all required clearances before release of equipment for fabrication.

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2. Manufacturer's standard catalog data describing and depicting each inverter set, batteries, charger and all ancillary equipment in sufficient detail to demonstrate complete specification compliance.

3. Drawings depicting each of the following:

   a. Central Inverter System with fast transfer and Pure Sine Wave that includes Self-Test/Self-Diagnostics features with scrolling LCD display that provides eight points of critical system status events.

   a. One-line diagram of each switch assembly and wiring diagram of each unit.

   b. A complete list of equipment and material to be provided, containing an adequate description of each separate item of equipment.

B. OPERATION AND MAINTENANCE MANUALS: Submit a complete sets of operating manuals outlining the step-by-step procedure required for system start up, operation, maintenance and shutdown. Include the manufacturer's name, model number, and a description of all equipment, complete with basic operating features. Describe in detail all maintenance procedures and a troubleshooting guide listing possible breakdowns and repairs for each piece of equipment. Include all factory service manuals, complete parts lists, simplified schematic diagrams of each system as installed, and the originals from which all posted instructions were made. Include complete rest reports specified in Part 3-Execution herein.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Provide emergency inverter systems and components, of types, ratings, and electrical characteristics indicated. Provide all system components thru one supplier to guarantee total system responsibility. Provide system and components capable of start and load transfer within 10 seconds of power outage.

2.2 ENVIRONMENTAL CONDITIONS:

A. Provide system components and accessories as required to ensure proper system operation at rated capacities under the following environmental conditions:

1. Altitude: 4800 feet above sea level
2. Maximum ambient temperature: 50 degrees C.
3. Minimum ambient temperature: 0 degrees C.
4. Seismic Zone as indicated in General Structural Notes.

2.3 CENTRAL INVERTER SYSTEM:

A. FEATURES (MINIMUM STANDARDS):

1. Pure Sine Wave output-compatible with all lighting loads
2. Fast Transfer System not to exceed 10 seconds.
3. An interactive LCD display for easy access to information

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4. Programmable settings
5. Self-Diagnostics that retain critical data logs.
6. Audible diagnostic alarm
7. Multiple Output Breakers (One to One)
    a. A minimum of (1) Input and (8) individual output Breakers

B. INPUT:

1. Voltage: See Plans for requirements
2. Current: See Plans for requirements
3. Protection: Input circuit breaker with fuse in series for easy selective coordination with upstream feed breaker
4. Power Factor: 0.5 lead to 0.5 lag.

C. BATTERY (MINIMUM STANDARDS):

1. Type:
    a. Lithium
    b. Valve regulated sealed lead-calcium 10 year pro-rated
2. Charger: 3 rate with Temperature Compensation
3. Recharge Time: 24 Hour recharge standard
4. Runtime: 90 Minutes, initial margin of 125 percent at 25 deg. C, 2 Hour Runtime optional
5. Protection: Automatic Low Voltage Disconnect (LVD) set at .67 VPC, Automatic Restart Upon Utility Power Return
6. DC Voltage: 24 VDC Nominal, 2.27 VPC float, temperature compensated
7. DC Current: 24 ADC nominal

D. PERFORMANCE (MINIMUM STANDARDS):

1. Capacity: 12kVA capacity
2. Overload: 120 percent for 10 minutes, 400 percent for 200 msec
3. Transfer Time: <2 msec as standard or can be factory adjusted
4. Output Distortion: Less than 3% THD
5. Crest Factor: TBD
6. Load Power Factor:0.5 lead to 0.5 lag
7. Protection: circuit breakers
8. Output Types: Normally On, Normally Off and Maintained Outputs

E. ENVIRONMENTAL (MINIMUM STANDARDS):

1. Operating Temp: 20 to 30 degrees Centigrade
2. Storage Temp: -20 to 70 degrees Centigrade (Electronics) 0-40 degrees Centigrade (Batteries)

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3. Relative Humidity: <95 % (non-condensing)

2.4 MANUFACTURER:

A. Myers-Illuminator

B. Emergi-Lite

C. Da-Lite

D. OnLine

PART 3 – EXECUTION

3.1 INSTALLATION OF ENGINE-GENERATOR SYSTEMS:

A. Install INVERTER as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices. Comply with NFPA and NEMA standards pertaining to installation of standby emergency systems and accessories.

B. Electrical Identification: Refer to Section 260553 for requirements.

3.2 GROUNDING:

A. Provide equipment grounding connections for system components.

3.3 TESTING:

A. Upon completion of installation and after building circuitry has been energized with normal power source, test inverter standby capability and compliance with requirements. Provide start-up and testing by factory authorized representative in accordance with manufacturer’s recommendations. Perform each of the following tests (as a minimum) and submit written report of results of each as part of the Operation and Maintenance Manuals required herein:

1. Mimic a normal power outage by de-energizing normal power source to the facility. Verify start, transfer, and operation of all loads satisfactorily. Re-energize normal power, and verify proper performance of load retransfer. Record and report all results.

3.4 TRAINING:

A. Conduct a minimum of 2-hour training course for operating staff or as designated by the Owner.

3.5 WARRANTY:

A. Warranty shall cover against defects in material and workmanship for a period of three

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years.

END OF SECTION 26 3213

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SECTION 26 4313

SURGE PROTECTIVE DEVICES (SPD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division 26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of SPD's work is indicated by drawings, schedules and specified herein. Work includes complete installation, electrical connections, testing, and commissioning.

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and IEEE Standards as applicable to wiring methods, construction and installation of SPD's. Comply with applicable requirements of ANSI/IEEE C62.11, C62.41.2 and C62.45; NFPA 70 285 (Type 2), 75, and 78; and ANSI/UL 1449 4th edition. Provide complete packaged units that have been listed and labeled by Underwriters Laboratory. UL surge ratings (UL 1449) must be permanently affixed to the SPS's device.

1.4 SUBMITTALS:

A. Refer to Section 260502 for electrical submittal requirements.

PART 2 - PRODUCTS:

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products manufactured by one of the following as indicated by "Location Category" herein.

1. Advanced Protection Technologies Inc.
2. Current Technology Inc.
3. Cutler Hammer, Inc.
4. L.E.A. International
5. Emerson Network Power Surge Protection Inc.
6. United Power Corporation
7. GE
8. Eaton
9. Surgelogic (Square D)

2.2 GENERAL:

A. Except as otherwise indicated, provide high energy surge protective devices, with high frequency line noise filtering, suitable for application in Category A, B, and C environments as indicated. Provide types, sizes, ratings and electrical characteristics indicated that comply with manufacturer's standard materials, design, and construction in accordance with published information and as required for a complete installation.

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B. Provide externally mounted SPD units only.

2.3 VOLTAGE SURGE SUPPRESSION – GENERAL:

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

6. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

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5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

    a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

        i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

        ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.

        iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

    b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

    c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

    d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

        i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection

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a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements

a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.4 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Provide a surge protective device on each switchboard and panelboard located on the emergency distribution system. Refer to table below for category type.

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

C. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

D. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

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2.5 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
5. The SPD shall be included and mounted external of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
3. The SPD shall be factory installed outside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be external to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.6 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings

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and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install SPD's as indicated in accordance with manufacturers recommendations and as necessary to meet requirements. Install with conductors of minimum length practicable, but in no case exceeding 30" in length; minimum conductor size - #6 AWG copper.

B. Install conductors in straight runs with a minimum of turns or bends (minimum bend radius to be 90 degrees). Do not splice phase or ground conductors in SPD's circuit. Torque all conductor terminations in accordance with manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of equipment, energize and demonstrate capability and compliance with requirements. Remove malfunctioning units, replace with new units and proceed with retesting.

END OF SECTION 26 4313

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SECTION 26 5100

INTERIOR AND EXTERIOR BUILDING LIGHTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Types of lighting fixtures in this section are indicated by schedule and include the following:

1. LED (Light Emitting Diode)

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and ANSI 132,1 as applicable to installation and construction of lighting fixtures. Provide lighting fixtures that have been UL-listed and labeled.

B. Components and fixtures shall be listed and approved for the intended use by a National Recognized Testing Laboratory (NRTL) including: UL, ETL, and CSA or equivalent

C. All led products shall comply with the latest version of Illuminating Engineer Society (IES) publications LM-79 and LM-80.

D. All fixtures shall be approved and listed on at least one of these 3 Qualified Fixture Lists; Energy Star, Design Lighting Consortium (DLC), or Lighting Design Lab.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):

1. LED:
    a. Cree
    b. Nichia
    c. Samsung
    d. Philips Lumiled
    e. Osram
    f. Xicato

2.2 INTERIOR AND EXTERIOR LIGHTING FIXTURES:

A. GENERAL:

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1. Provide lighting fixtures, of sizes, types and ratings indicated complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, LED drivers, starters, and wiring. Label each fixture with manufacturer's name and catalog number. Provide all enclosed fixtures with positive latch mechanisms; spring tension clips not acceptable. Provide all exterior fixtures with damp or wet location label as required by application.

B. SUPPORT REQUIREMENTS:

1. Provide all pendant and stem hung fixtures with flexible ball joint hangers at all points of support. Equip hooks used to hang fixtures with safety latches. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain, or safety cable.

C. LIGHT EMITTING DIODE (LED) LUMINAIRES:

1. LED luminaires that can be serviced in place shall have a disconnecting means internal to the luminaries to disconnect simultaneously from the source of supply all conductors of the driver, including the grounded conductor. Disconnects shall not be required under the following exceptions:

a. Luminaries located in hazardous locations.

b. Luminaries used for egress lighting.

c. Cord-and-plug luminaries.

d. In industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.

e. Where more than one luminaire is installed in a space and where disconnecting the supply conductors to the luminaire will not leave the space in total darkness.

f. Provide LED luminaires which are tested in accordance with IES LM-79, diodes tested in accordance with IES LM-80, and provide a minimum R9 rating of ≥ 50 (unless specified differently), a CRI rating of ≥ than 80 and L70 (6K) = 50,000 hours (IES TM-21). Provide with 0-10V dimming drivers as standard.

g. The fixture manufacturer(s) shall warrant the luminaires, in their entirety, to be free from defects in material or workmanship for at least 5 years from date of manufacture. Provide warranty in accordance with other sections of this specification and include a certificate of warranty from the fixture manufacturer with extended warranty information and proper forms and procedure description.

D. DIFFUSERS:

1. Where plastic diffusers are specified, provide 100 percent virgin acrylic compound; minimum thickness, .125 inches.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standards of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. Coordinate with other work as appropriate to properly interface installation of lighting

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fixtures with other work. Consult architectural reflected ceiling plan for exact location of all lighting fixtures.

C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of fixtures. Support all ceiling mounted fixtures from the building structure; independent of the ceiling system, unless noted. Support each recessed fixture (fluorescent incandescent, and/or HID) from the building structure with #12 ga. steel wire attached to each corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support surface mounted ceiling fixtures from channel. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. Feed each recessed fixture directly from an outlet box with flex conduit as required; do not loop from fixture to fixture. See plans for additional details.

D. FIXTURE WHIPS:

1. Provide each lay-in light fixture with at least 36" (Not to exceed 72") of 3/8" steel flexible conduit.

2. With-in spaces utilizing 0-10v control schemes ie: Room Controllers, the fixture whip shall be comprised of a MC-PCS Cable (see Section 26 0532 Conduit raceways) with at least 36” and not to exceed 72” in length located above removable grid ceilings.

E. Coordinate lighting in mechanical room with duct and equipment locations to avoid obstruction of illumination.

F. Provide gypsum board protection as required, (acceptable to fire official having jurisdiction) to ensure fire rating of each ceiling that the fixtures are installed in.

G. COORDINATION MEETINGS:

1. Meet at least twice with the architect and ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.

   a. Coordinate mounting height of pendant and wall mounted fixtures.

   b. Coordinate conduit layout in all open ceiling spaces e.g. Gym, Commons, Auditorium, etc. with architect prior to rough-in.

2. Meet at least twice with the AV/Intercom systems Installer. Hold first meeting before submittal of shop drawings to coordinate each AV equipment, speaker mounting condition with ceiling type. During second meeting, coordinate AV equipment, speaker layout in each area.

3. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all fixtures and duct work in all areas.

H. ADJUST AND CLEAN:

1. Clean lighting fixtures of dirt and debris upon completion of installation.

2. Protect installed fixtures from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.

B. Where possible, correct malfunctioning units at site, then retest to demonstrate

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compliance; otherwise remove and replace with new units, and proceed with retesting.

C. At the time of Substantial Completion, replace lamps in interior lighting fixtures that are observed to be noticeably dimmed after the Contractor's use and testing, as judged by Architect/Engineer.

D. GROUNDING:

1. Provide equipment grounding connections for each lighting fixture.

END OF SECTION 26 5100

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SECTION 26 5600

EXTERIOR AREA LIGHTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Types of lighting fixtures in this section are indicated by schedule and include the following:

1. LED (Light Emitting Diode)

B. Excavation and backfilling for exterior area lighting poles, standards and foundations are specified in applicable Division-26 general provision sections.

C. Concrete for embedding poles, and for pole foundations and footings is specified in other sections of specification. Provide pole bases under this section of the specification.

D. Refer to other Division-26 sections for cable, wire and connectors required in connection with exterior area lighting poles and standards.

1.3 QUALITY ASSURANCE:

A. Comply with NEC, NEMA and ANSI/IES requirements as applicable to location and installation of lighting poles and standards. Provide lighting components and fittings that are UL-listed and labeled.

B. Comply with other portions of specification as applicable for forming, splicing, and curing of concrete bases provided under this section.

1.4 SUBMITTALS:

A. Refer to Section 26 0502 for electrical submittal requirements.

PART 2 - PRODUCTS

2.1 **MANUFACTURER**: Subject to compliance with requirements, provide products as scheduled on drawings.

A. CONCRETE: 3000 psi Class.

B. LIGHT FIXTURE POLES: Provide light fixture poles that comply with the following minimum requirements.

1. The pole shaft constructed of seamless aluminum alloy per requirements of ASTM B221. Include a flush covered hand hole in each pole with finish hardware. Provide a permanent marking with the manufacturer name inside the hand hole for easy recognition.

2. Provide aluminum alloy anchor base welded to the pole shaft. Welding must comply with AWS Specification D1.2, Structural Welding Code – Aluminum. The complete assembly must be heat-treated to a T6 temper.

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3. Provide super durable thermosetting polyester power coat paint, a minimum of 1.5 mils thick along the entire length of the pole.

4. Include aluminum nut covers for a “Shoe Base” trim.

5. Provide a 10 year minimum guarantee, which covers the pole structure and paint.

6. Provide vibration dampening in poles.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install area lighting units as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NESC and NEMA standards and with recognized industry practices to ensure that lighting units fulfill requirements.

B. Coordinate with other work as necessary to properly interface installation of roadway and parking area lighting with other work.

C. Comply with NEC 300-5 (or State of Utah requirement, whichever is most stringent), for raceway burial depth.

D. Mount lighting units on concrete bases as indicated, complete with anchor bolts and reinforcing bars. Coordinate proper size and location of all bases as required to ensure proper installation. Provide 3000 psi class concrete; hand rub all exposed concrete to uniform, smooth finish.

E. Deliver poles to job site with factory finish paint.

F. Set poles and standards plumb. Support adequately during backfilling, or anchoring to foundations.

G. Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling.

3.2 GROUNDING:

A. Provide equipment grounding connections for each lighting unit installation.

END OF SECTION 26 5600

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SECTION 26 9000

SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full.

C. Refer specifically to Section 01810 and Section 01815 for responsibilities to aid a commissioning agent.

1.2 DESCRIPTION OF WORK:

A. Additional independent commissioning will be provided per contract documents. Division 26 contractor shall provide system commissioning per specifications separate from that of the independent commissioning agent. Division 26 contractor will be required to assist the commissioning agent with access to shop drawings and to various equipment required to be commissioned.

B. The purpose of the commissioning process is to provide the Owner/operator of the facility with a high level of assurance that the electrical and associated electrical systems have been installed in the prescribed manner and operate within the performance guidelines set in the design intent. The Commissioning Authority (CxA) will provide the Owner with an unbiased, objective view of the system installation, operation, and performance. This process is not to take away or reduce the responsibility of the design professionals or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The CxA will be a member of the construction team, cooperating and coordinating all commissioning activities with the design professionals, construction manager, contractors, subcontractors, manufacturers, and equipment suppliers.

C. The systems requiring commissioning are:

1. Network Lighting Controls
2. Occupancy Sensors
3. Daylighting/Photocell Systems
4. Cable Trays
5. Fire Alarm Systems
6. Overload Protected Devices
7. Inverter Systems
8. Panelboards
9. Lighting
10. Lighting Controls
11. Receptacles
12. Transformers
13. Raceways
14. Switchgear
15. Main Distribution Boards
16. Switchboards
17. Variable Frequency Drives

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18. Metering Devices
19. Surge Protection Systems
20. Electrical Distribution
21. Motor Starters
22. Disconnects
23. Combination Starters
24. AV Systems
25. Security Systems
26. Intercom Systems

PART 2 – PRODUCTS: Not Used

PART 3 – EXECUTION: Not Used

END OF SECTION 26 9000

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SECTION 27 1500

TELEPHONE/DATA SYSTEMS

PART 1 – GENERAL

1.1 SCOPE OF DOCUMENT:

A. The following are project specifications that all cabling systems must adhere to. These specifications apply to all installers (hereinafter referred to as “the Contractor”) for all sites, that require, standards-compliant structured cabling systems and shall be used for all the installation, testing, and acceptance of the information transport systems as described in the attached specifications. Prices quoted of the installation facilities shall be all-inclusive and represent a complete installation at such sites as prescribed in this specification and contract documents. The Contractor shall be solely responsible for all parts, labor, testing, acceptance and all other associated processes and physical apparatus necessary to turn-over a completed system fully warranted and operational for acceptance by the Customer. Final acceptance of the installation shall be in writing by the Architect and Engineer.

B. In all instances where Standards are cited, it is assumed Installer will have familiarity with and implicitly follow the recommendations of the most current version of the Standard referenced at the time of installation. Compliance with most current Standards is the sole responsibility of the Contractor.

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-7 Firestopping, apply to work of this section.

C. Division-26 Basic Materials and Methods sections apply to work specified in this section.

D. Refer to and coordinate with specification 27 4100 for any audiovisual equipment requiring UTP based category and/or optical fiber cabling and connectivity. Division 27 1500 shall provide installation and execution requirements for all category and/or optical fiber cabling and connectivity required within the audiovisual system

1.3 SCOPE OF WORK:

A. The extent of telephone/data system work is indicated by drawings and is hereby defined to include, but not be limited to racks, cabinets, patch panels, cables, raceway, outlet boxes, device plates, backboard, and grounding. Contractor is responsible for installation of all specified and unspecified necessary and miscellaneous items required for delivery of a complete and functional data cabling and device system.

B. Contractor shall provide complete cable and outlet system as indicated on the drawings and described herein. Work shall include all associated infrastructure transmission components and support appliances including, but not be limited to cable, jacks, terminal blocks, racks, cabinets, wire management, labeling, transient voltage surge suppression, patch cords, telecommunications grounding system and all terminations as specified herein.

C. Contractor shall provide system testing as described herein using up-to-date and industry accepted Level IIIe, IV, V test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1. All testers used shall be factory calibrated within one year of use with references set daily prior to testing.

D. All active equipment (electronics) will be owner furnished and owner installed.

E. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other associated processes and physical apparatus necessary to turn-over the completed

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system fully warranted and operational for acceptance by Owner and Engineer.

F. Contractor shall provide all labor, materials, tools and equipment required for the complete installation of work called for in the Construction Documents.

G. Copper solution must match optical fiber solution and be provided by the same manufacturer. No two separate warranties are acceptable for the copper connectivity and optical fiber connectivity.

H. Contractor shall provide 1-1" EMT conduit from telecommunications outlet/connector to cable tray.

1.4 CONTRACTOR QUALIFICATIONS

A. The contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to voice and data network systems. The Contractor shall at a minimum possess the following qualifications:

1. Must have at a minimum (1) RCDD certified individual employed full time at the time of bidding and throughout entire project. **PROVIDE PROOF OF RCDD CERTIFICATION IMMEDIATELY UPON JOB AWARD**.
2. Approved and certified by connectivity manufacturer. Provide proof of certification immediately upon job award.
3. BICSI Certified Installers or equivalent.
4. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
5. Have a minimum of 5 years in the communications structured cabling business and be able to provide three owner references for the type of installation described in this specification for projects within the last 18 months.
6. Personnel trained and certified in fiber optic cabling, splicing, termination and testing techniques. Personnel must own not rent a light meter or fiber test adapter head, and OTDR and shall be factory certified by the manufacturer of the products being installed.
7. Personnel trained in the installation of pathways and support for housing horizontal and backbone cabling.
8. Personnel knowledgeable in local, state, province and national codes, and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
9. Be factory certified by the manufacturer used in installation of all transmission components of all copper and fiber links and able to provide the manufacturer warranty.

1.5 QUALITY ASSURANCE

A. Required Pre-Telecommunications Construction Meeting with Communications Engineer: Electrical contractor/representative AND Communications Contractor will be required to attend a pre-communications construction meeting (approximately 30-60 minutes) with Communications representative in the electrical engineer's office prior to communications construction commencement. This meeting will address any questions on the part of the contractor and the expectations of the Engineer with regard to specifications, plans and site visits for both rough and finish electrical work.

B. Owner IT Contact:

1. Spencer Jensen, Technology Support Manager.

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a. DO *NOT* ORDER ANY EQUIPMENT WITHOUT THE WRITTEN REVIEW OF SPENCER JENSEN.

C. BNA IT Contact:

1. Drayton Bailey; drayton@bnaconsulting.com, 801-532-2196
2. Son Nguyen; snguyen@bnaconsulting.com, 801-532-2196

1.6 APPLICABLE CODES AND STANDARDS

A. Contractor is responsible for compliance with all applicable portions of the NEC code as to type of products used and installation of components. All materials used shall be products and materials that have been UL-listed and labeled. All installed products shall comply with applicable NEMA standards for low loss extended frequency cable.

B. In addition, installation shall adhere to the following Standards:

1. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises, or most recent edition at the time of installation
2. ANSI/TIA-568-C.1 – Commercial Building Telecommunications Cabling Standards, or most recent edition at the time of installation
3. ANSI/TIA-568-C.2 - Balance Twisted Pair Communications and Components Standards, or most recent edition at the time of installation
4. ANSI/TIA –942 -Telecommunications Infrastructure for Data Centers, or most recent edition at the time of installation
5. TIA-569-B - Commercial Building Standard for Telecom Pathways and Spaces, or most recent edition at the time of installation
6. ANSI/TIA-606-A – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, or most recent edition at the time of installation
7. ANSI/NECA/BICSI-607 - Commercial Building Grounding/Bonding Requirements, or most recent edition at the time of installation
8. ANSI/TIA 1152 – Testing of Copper Links
9. BICSI Telecommunications Distribution Methods Manual, 13th edition or most recent edition at the time of installation.
10. TIA 758-A - Customer owned Outside Plant Telecommunications Infrastructure Standard (2004), including all applicable addenda and the most recent revision at the time of installation.
11. BICSI Information Transport Systems Installation Manual - 5th edition or most recent edition at the time of installation.
12. ANSI/NFPA-70 - 2017 National Electrical Code, revision, or most recent revision at the time of installation.
13. ANSI/IEEE C-2 - 2017 National Electrical Safety Code or most recent revision at the time of installation.
14. OSHA Standards and Regulations All applicable
15. Local Codes and Standards All applicable

C. Note: Anywhere cabling standards conflict with electrical or safety codes, Contractor shall defer to NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either. Knowledge and execution of applicable codes is the sole responsibility of the Installer. Any code violations shall be remedied at the Contractor's expense.

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1.7 ACCEPTABLE MANUFACTURERS:

A. General:

1. Unapproved product substitutions are not allowed. Contractor wishing to substitute any products for those expressly specified shall submit three samples of the alternate product to Engineer no less than two weeks prior to the last addendum accompanied by all engineering documents, drawings and third party test data proving mechanical and transmission equivalency. Acceptance of substitutions shall be received from Engineer in writing. All unapproved substitutions installed shall be removed by Contractor who shall assume all costs for removal and replacement with approved products. Such costs shall include, but not be limited to labor, materials, as well as any penalties or fees for late completion.

B. APPROVED MANUFACTURERS:

1. Contractor shall select only one line item in the each section of Parts 2, 3, and 4. Contractor shall NOT utilize multiple line items for the project within each Part. For example, if Panduit / General Cable is selected to be used for the project, all copper cabling and connectivity shall be by Panduit or General Cable. No other manufacturer or combination of manufacturers may be used for the copper cabling or connectivity equipment.

2. Copper Cabling / Connectivity Approved Manufacturers:

a. Leviton / Berk-Tek

3. Fiber Cabling Approved Manufacturers

a. Same manufacturer from Part 2.

4. Non-Cabling / Connectivity Approved Manufacturers:

a. Same manufacturer from Part 2.

1.8 SUBMITTALS: Refer to Section 26 0502 for requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All products shall be in new condition and UL listed.

B. Provide complete raceway, outlet boxes and miscellaneous items. All conduit utilized shall be EMT grade.

C. Provide 5” x 2.875" (or 4-11/16” x 3.25” square) deep square outlet box at each outlet location with single gang plaster or tile ring. Provide wall board adapters / accessories as necessary.

1. Approved solutions:

a. RANDL 5 Square Telecommunications Outlet Box Model TX-550-YY where “X” could be a bracket box and “YY” could be knockout arrangements.

b. Hubbell Large Capacity Wall Box Model HBL260. If a 2” knockout is required for installation purposes, provide this box.

D. Communication grounding and bonding shall be constructed and installed to meet or exceed the requirements of the National Electrical Code (NEC), IEC 1000-5-2 and ANSI/J-STD--607-A throughout the entire grounding system.

E. All termination hardware shall be rated to meet specified cabling specifications.

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2.2 ENTRANCE FACILITY (EF) / EQUIPMENT ROOM (ER) / TELECOMMUNICATIONS ROOM (TR)

A. General:

1. Contractor shall be responsible for the adequate and appropriate design of all racking systems, paying particular attention to sizing of all cable management troughs and supports both horizontal and vertical installation of patch panels and wire management into rack.

2. Provide line surge suppressors at main telephone board in ER for all incoming phone lines if not provided by service provider. Provide ground connection to TMGB.

B. Provide the following, see specifications for each item in this document:

1. Wall Linings in each EF, ER, and TR:

a. In addition to the architectural walls, provide plywood wall lining that mounts at 8" A.F.F that shall:

i. Be fire-rated or treated on all sides with at least two coats of fire-resistant light-colored paint. Fire-retardant plywood is also acceptable. Leave fire rated stamp on plywood unpainted.

ii. Have walls lined with A/C grade or better, void-free plywood, 8 feet high with a minimum thickness of ¾". See plans for additional wall locations.

iii. Install the plywood with grade A surface exposed. Plywood shall be securely fastened to wall-framing members to ensure that it can support attached equipment.

iv. Use flush hardware and supports to mount plywood.

v. Plywood shall be void free and kiln-dried to a maximum moisture content of 15 percent to avoid warping.

2. Main Cross Connect (MC) / Horizontal Cross Connects (HC):

a. Floor Mounted Racks (See Plans for Locations):

i. Provide two post 19" wide minimum 7' tall EIA aluminum rack with ANSI/EIA 310-D rail size, 45RU capacity, painted black, top flanges, and mounting holes.

ii. Provide paint-piercing washers to electrically bond racks.

iii. Approved Equipment - Rack

1. Chatsworth 55053-703 Standard Rack

iv. Approved Equipment - Cabinet

1. Chatsworth ZA41-A1100-71 ZetaFrame Cabinet. 79.4"H x 31.5"W x 31.5"D.

b. Flat Copper Patch Panels:

i. Provide flush mount patch panels of required number and size to accommodate shown telecommunications outlets on plans. (No horizontal cable managers are required)

ii. Size panels to provide minimum 25% spare capacity. Fill all available space in remaining patch panels so that panels are fully populated.

iii. Support Category 6 or higher applications.

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iv. Shall accommodate 8-Pin 8-Contact (8P8C) ports.

v. Mount to standard EIA 19" rack.

vi. Each patch panel shall include mounted behind it one "towel rack" style cable support bar for each 24 connections that the Contractor shall dress cables using hook and loop type cable ties.

vii. Approved Equipment

Manufacturer	**Model Name**	**Flat Patch Panel**
Leviton	Leviton	49255-H48 - QUICKPORT

c. Fiber Shelves and Cassettes

i. Provide fiber shelves and cassettes as required to complete project with a maximum of 36 strands in 1RU.

ii. Provide rack mounted, sliding type fiber trays as required to complete project.

iii. Provide OM4 fiber adapter patch panels that contain modular, dual LC adapter panels as required to complete project. Color for OM4 ports to be aqua, color for OS2 ports to be yellow.

iv. Provide minimum 25% spare capacity of fiber adapter panels. Provide additional rack mounted fiber trays/fiber adapter patch panels if necessary to meet 25% spare capacity requirement.

v. Approved Equipment

Manufacturer	**Model Name**	**Fiber Shelf**	**Cassette (OS2)**
Leviton	Opt-X	5R1UM-S03	SPLCS-24L

e. Vertical Cable Managers:

i. Provide a vertical cable management panel on both sides of rack.

ii. Manager shall consist of a metal backbone with cable management fingers that align with EIA rack spacing. Provide cover for all cable management.

iii. Vertical panel shall be able to manage all the cable on the rack without the aid of horizontal cable managers.

iv. Size all vertical cable managers according to factory recommendations for the cable being installed. In no case shall design require more than 35% fill ratio when rack is fully populated.

v. Provide molded plastic slack spools in front to facilitate minimum bend radius compliance.

vi. Minimum width to be 6".

vii. Approved Equipment

1. Leviton 8980L-VFR (8")

f. Horizontal Cable Management

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i. Provide horizontal cable management capable of managing copper and fiber cables.

ii. Manager shall consist of bend radius control throughout the fingers, pass through holes, and transitions between horizontal and vertical pathways.

iii. Provide front hinged cover that shall open 180 degrees.

iv. Manager should mount to standard EIA 19" rack.

v. Size according to factory recommendations for the cable being installed. In no case shall design require more than 40% fill ratio when rack is fully populated.

vi. Approved Equipment

1. Leviton 492RU-HFR (2RU) or 491UR-HFR (1RU)

g. Power Distribution Units (PDUs)

i. Provide unmonitored vertical mount power outlet unit with amperage and voltage indicated on plans. Unit shall have (24) NEMA 5-20R receptacles per circuit and internal thermal breaker of power outlet unit's listed amperage. Provide data cable to each PDU for reporting.

ii. Approved Equipment

1. Leviton P1043-10S

h. Uninterruptible Power Supply (UPS)

i. Provide 120V rack-mounted UPS for each rack/cabinet on project with capability of providing backup to the full connected load for a minimum of 60 minutes. Calculate required VA rating by reviewing electrical power drawings and assume 1,800VA per cabinet and per rack.

ii. Provide a minimum of (2) output receptacles.

iii. Provide submittal for each UPS showing run time graph that shows compliance with the specifications.

iv. Approved Manufacturers

1. APC
2. Eaton

i. Cable Tray (only within the EF/ER/TR)

i. This cable tray section is only applicable within the EF/ER/TR and does not apply outside of those spaces. See specification 26 0536 Raceway Systems for any cable tray requirements outside of the EF/ER/TR (if applicable to the project.)

ii. Provide overhead basket tray:

1. Mount tray 18" above racks unless otherwise noted. Provide additional vertical tray as required to provide pathways between the tray above racks and the tray entering the communications room from outside.

2. Size tray according to quantity of cables entering space. However, in no case shall the tray be smaller than 4" high by 6" wide. Do not exceed 50% cable fill of tray.

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3. For overhead installations, utilize profile supports to support tray every 5'-0".
4. For wall mounted installations, utilize shelf brackets to support tray every 5'-0".
5. Provide blind ends to provide closure for a dead-end tray.
6. Provide cable rollers, two at each 90-degree bend. A radius shield or horizontal bend radius may also be used in lieu of cable rollers.
7. Provide drop-out fittings, or waterfalls, over each cabinet of sufficient quantity to provide an acceptable path for cables to enter equipment. For single cables leaving the tray, utilize a cable drop-out in lieu of a waterfall.
8. Cables must enter the racks from the top.
9. Provide conduit to tray adapters for each conduit terminating to cable tray.

2.3 CABLING DISTRIBUTION SYSTEMS AND MISCELLANEOUS EQUIPMENT

A. General:

1. Provide plenum rated cable/connectors if required, cabling/connectors must be appropriate for the environment that it is installed in. Provide wet rated cable for all wet locations, including any conduit in or below slab on grade.
2. Contractor shall be responsible for sizing all pathways such that newly installed cable represents not more than a 35% fill as per manufacturer's directions. Overfilled pathways are the sole responsibility of the Contractor who shall remove and reinstall at Contractors expense.
3. Provide products rated for the environment that it is installed in (i.e. riser, plenum, outdoor). All cabling installed in wet locations (i.e. underground conduit, conduit in slab on grade) shall be listed for use in wet locations.

B. Backbone Cabling Distribution System – Optical Fiber

1. General:
   a. Provide an optical fiber backbone cabling distribution system between telecommunication spaces. Provide OFNR or OFNP as required. Provide 900μm tight-buffered optical fiber cable for premise cable and loose tube for outside plant cable.
   b. Provide fiber jumpers of appropriate length and cable type for each terminated optical fiber port to be connected.
2. Single-Mode Fiber Optic Cable (OS2)
   a. All singlemode optical fiber cabling shall be 9/125μm and yellow.
   b. Approved Equipment
      i. Leviton Indoor/Outdoor Plenum Adventum with Armor-Tek 12-strand OS2. Leviton LTPK012-AB0403.
3. Connectors:
   a. Provide LC-Duplex Connectors.
   b. Mechanical connectors are acceptable. Do not utilize polish type connectors. Clean all preterm connectors, no exceptions.

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c. Approved Manufacturers:

i. Leviton 49990-SDL

4. Primary Protection (Surge Protection)

a. General

i. Provide surge protection for each pair of copper cabling between buildings and any end point devices that are located outside. For example, if a camera is mounted or located on the exterior of the building—surge protection is required.

ii. Surge suppressions shall be achieved through 5-pin, solid state, plug-in type modules for each conductor pair.

iii. Provide necessary grounding of equipment to building electrical ground. Size all grounding conductor based on distance to electrical ground according to the requirements of this section.

iv. Provide 25% spare modules.

v. Approved Equipment

1. For data outlets where POE is present

a. ITWLinx 1Gb CAT6-POE.

2. For outlets where no POE is present

a. ITWLinx 1Gb CAT6-LAN

3. For copper multi-pair backbones

a. ITWLinx ML25-CAT5-75

4. If power is required on all four pairs. (Note: If Cisco switches are connected via a copper backbone, this product is required.)

a. ITWLinx 1Gb CAT6-75

C. Horizontal Cabling Distribution System – Balanced Twisted Pair

1. General:

a. Provide appropriate number of Category 6A horizontal cables, patch cables, work area cables, for all terminated data drops, between switches, etc. so that building-wide networking will be operational once all installation is complete.

2. Horizontal Cabling

a. Provide Cat 6A UTP, min-compliant, 4-Pair 100Ω Balanced Twisted Pair Cable to all locations shown on plans.

b. Provide cabling rated for the environment that it is installed in (i.e underground conduit, conduit in slab on grade). All cabling installed in wet locations shall be listed for use in wet locations.

c. Provide a minimum of (2) cables, unless otherwise noted, to each location shown on plans.

i. Provide (2) Category 6A cables to each wireless access point (WAP).

a. Locate drops in near center of classroom in biscuit jack above ceiling grid, label on ceiling grid on locations that biscuit is used instead of faceplate.

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b. WAPs should be provide at a minimum of the following locations: Stage, Gym Cafeteria, Office Areas, Counseling office, Dance, Wrestling, Band, Choir, Foods, Common Area where kids would be sitting. See plans for additional locations and provide accordingly.

c. Wireless access points to be owner furnished, Or installed (OFOI)

d. Horizontal cable shall follow the color scheme. Provide matching Keystones and plates:

i. Blue; Data Cabling

ii. Orange; Cameras

iii. Yellow; Intercom

iv. White; AV

v. Blue; IPTV/TV

vi. Purple; WAPs

e. Approved Equipment

Manufacturer	**Model**	**Plenum**
Berk-Tek	LANMark-10G2	10130484 (Blue, CMP)

f. Surface Box/Biscuit Box [

i. Provide an 1 or 2-port surface/biscuit for each camera and WAP, and any other locations indicated or as required.

ii. Box shall match provided cabling manufacturer.

3. Patch and Work Area Cables:

a. Provide and install (1) 7-foot-long patch cable for each workstation and (1) 2 foot or 3 foot patch cable for each patch panel port in the TR/TC. Provide half of the TR/TC patch cables in 2 and 3 foot lengths and the remaining half in 7 foot lengths.

b. No patch or work area cords shall in any case exceed in total 10 meters as per TIA Standard unless design includes Standards compliant MUTOA (multi-user termination outlet) and work area cord adjustments are made according to recommendations for zone cabling contained within TIA 568-C or most recent revision at the time of installation. Coordinate with owner for preferred patch cord lengths at patch panel and work area.

c. Copper patch cord and work area outlet cabling must be provided by the same manufacturer and meet the same performance standards as the horizontal cabling.

d. Patch cord and work area cables shall match the horizontal cabling color.

e. Provide 1 Meter and 2 Meter, 2-strand optical fiber patch cable for each patch panel (50/50 Split), utilizing same performance standards and connector types as specified for the backbone. The cable shall be provided by the same manufacturer and meets the same performance standards as the backbone optical fiber.

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4. Telecommunications Outlets/Connectors (See Plans for Locations):
    a. Flat/Flush Faceplates:
        i. Provide modular type information outlets with flat telephone jack or data outlet. Provide single gang faceplate kits to allow up to six data or voice jacks as shown on plans. Provide faceplate kits for wall outlets in colors and materials that match power wiring device plates. Provide faceplate kits that allow labeling schemes described herein. Faceplates shall accept STP, UTP, fiber optic or audio/video modules as an option.
        ii. Blank off all unused ports.
        iii. Color: Standard color as selected by owner/architect.
    b. Flat Connector:
        i. Color: Standard color as selected by owner/architect.
    c. Approved equipment
        i. Connector: Leviton 6110G-Rx6
        ii. Flat Faceplates:
            1. Plastic: Leviton 42080-xxL
            2. Stainless: 43080-xLx

PART 3 – EXECUTION

3.1 GENERAL

A. Prior to pathway rough-in, low voltage contractor shall meet with electrical contractor to review pathway installation requirements.

B. Pathway Requirements:
    1. General:
        a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.
        b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Field coordinate alternate pathway requirements with other trades onsite. New pathways shall not exceed distance limitations defined within this specification. Notify the Engineer of the changes for final approval prior to proceeding with the change.
        c. Paint all electrical boxes and their covers for the telephone and data system green (Kwal Paint Java Green AC098N).
    2. Cable Tray Within EF/ER/TR:
        a. Wrapped around room (wall support is acceptable)
        b. Along equipment rows leading to cross-connects.
        c. Ground tray to TGB or TMGB (whichever is closer) utilizing #6CU bare wire.

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d. Coordinate tray locations with lighting, air-handling systems, and fire extinguishing systems so that fully loaded trays will not obstruct or impede their operation.

i. Install cable tray under mechanical components for access for future cabling needs; coordinate the mounting height of the cable tray with Owner IT Representative prior to installation. Do not install cable tray at the top of a ceiling which is inaccessible due to the excessive height.

3. Racks / Cabinets:

a. Racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.

b. Racks shall be placed with a 36-inch (minimum) clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.

4. Conduits:

a. For any interior/exterior conduit 4" and larger, provide (3) 1.25" plenum-rated corrugated innerducts.

b. Flexible conduit is not acceptable as cable tends to creep, shift, or have sheath damage.

c. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.

d. Conduit runs shall not have continuous sections longer than 100 feet without a pull box and may only be filled to 35% capacity.

e. Ream all conduit ends and fit with an insulated throat nylon bushing with non-indenter type malleable steel fittings to eliminate sharp edges.

f. Telecommunications conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.

g. Conduits that enter an EF/ER/TR must terminate near the corners to allow for proper cable racking. Terminate these conduits as close as possible to the wall where the backboard is mounted to minimize the cable route.

h. Terminate conduits that protrude through the structural floor 1" to 3" above the surface within an EF/ER/TR.

i. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.

j. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.

k. When the number of conduits requires more than one row, restrict the number of rows to two wherever practicable.

5. Open Top Cable Support Requirements:

a. J-Hooks not permitted.

6. Pull Box Requirements:

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a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.

b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90-degree bends, or contain a reverse bend.

c. Conduits that enter the pull box from opposite ends should be aligned.

d. Pull boxes shall have a length 12 times the diameter of the largest conduit.

e. All pull boxes must be accessible.

C. Cabling System:

1. Follow T568B scheme for copper cabling terminations.

2. Life Safety Related Cabling:

a. Provide the specified category cabling in 1” conduit from elevators and or lifts. Cabling shall terminate at telephone service demarcation point.

b. Provide the specified category cabling in 1” conduit for two phone lines to the fire alarm control panel back to telephone service demarcation point.

c. Provide the specified category cabling in 1” conduit for the two-way communication system Main Control Panel back to telephone service demarcation point.

3. Miscellaneous Related Cabling:

a. Provide the specified category cabling in 1” conduit for two data connections to Intrusion Detection System head-end back to EF or demarcation room. Refer plans for exact locations.

b. Provide the specified category cabling in 1” conduit for two data connections to Access Controls System head-end back to closest data rack. Refer to plans for exact locations.

c. Provide the specified category cabling in 1” conduit for one data connection to Intercom head-end back to closest data rack. Refer to plans for exact locations. Provide specified category cabling and conduit between intercom head-end and access control panel.

d. Provide the specified category cabling in 1” conduit for Main Building Management System (ATC Panels, etc) back to nearest ER/TR room. Refer to Mechanical plans for exact location.

e. Provide the specified category cabling in 1” conduit for Advanced Energy & Power Metering System back to Main Building Management System Panel. Refer to plans for main switchboard location.

4. Backbone cables shall be installed separately from horizontal distribution cables. Provide plenum rated innerduct if required, innerduct must be appropriate for the environment that it is installed in.

5. It is acceptable to install innerduct within cable tray as long as the fill ratio is not exceeded.

6. Fiber slack shall be neatly coiled within the fiber enclosure or cable tray. No slack loops shall be allowed external to the fiber panel. Each cable shall be individually attached to the respective fiber enclosure by mechanical means.

7. Provide a minimum of one balanced twisted pair cable to each voice outlet and one balanced twisted pair cable to each data outlet shown on the drawings unless noted otherwise on the drawings.

8. Service Loop Requirements

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a. Provide a minimum 6” service loop in each communications system junction box for balanced twisted pair. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.

b. Provide a minimum 10’ service loop in each EF/ER/TR/TE.

c. Provide a minimum 2’ service loop at each stub-up or at each transition from conduit to cable tray.

d. Provide a 5’ service loop in the ceiling before the conduit travels down the wall and terminates into the communications junction box.

e. Provide a 25’ loop at all wireless access point (WAP) locations above the ceiling.

9. Provide modular jacks for each installed cable at outlets shown on drawings. Blank off all unused ports on faceplate.

10. Provide Velcro type ties for all cables and install in a neat and workmanlike manner. Where applicable, use plenum rated Velcro. Where cable is installed in cable tray, bundle a maximum of 25 cables in each Velcro tie. No zip ties are permitted whatsoever, even for temporarily hanging cables during the installation process

11. The bending radius and pulling strength requirements of all backbone and horizontal cables shall be observed during handling and after installation. Use pulling compound as recommended by manufacturer.

12. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft) from the telecommunications outlets in the work area to the horizontal cross connect.

13. The combined length of all patch cords in the EF/ER/TR and the work area shall not exceed 10m (33 ft)

14. No splices are allowed.

15. In a false ceiling environment, a minimum of 3 inches shall be observed between cable supports and false ceiling. At no point shall cable(s) rest on acoustic ceiling grids or panels.

16. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

17. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

18. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

19. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.

20. Pair untwist at the termination shall not exceed 0.125”. The cable jacket shall be maintained as close as possible to the termination point.

21. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

22. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to

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building supports or hangers or to additional blocks or anchors specifically installed for this purpose.

D. Grounding System:

1. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
2. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
3. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
4. All active equipment from owner shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
5. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.
6. Patch panels shall be bonded to racks using the appropriate bonding screws. Mounting rails may utilize cage nuts, threaded holes or thru hole mounting fasteners to secure patch panels to the rails.
7. Bond cable tray, raceway system, structural steel and all other metal equipment located within EF/ER/TR to the grounding bus bar utilizing copper conductors per the following schedule:
    a. ≤25’ - #34
    b. ≤50’ - #2
    c. ≤66’ - #2/0
    d. ≥67’ - #3/0
8. Provide 4” X 12” X ¼” CU Telecommunication Main Grounding Bus Bar (TMGB) with bonding conductor per schedule above to Intersystem Bonding Terminal (IBT) in each telecommunication room (EF/ER/TR) with a main cross-connect (MC). Provide 20% spare termination spaces on bus bar, provide additional bus bars as necessary to accommodate spare.
9. Provide 2” X 12” X ¼” CU Telecommunication Grounding Bus Bar (TGB) with bonding conductor per schedule above to TMGB in each room with a horizontal cross-connect (HC).
10. Refer to electrical diagrams for additional ground connection requirements.

E. Electromagnetic Compatibility:

1. General:
    a. Do not install power feeders above or within the telecommunications room. Do not install telecommunications conduits above electrical panelboards, switchboards, transformers, motor control centers, etc.
    b. Where telecommunication cable is installed in grounded, metallic conduit near power cables, the power cables shall be kept physically separated from telecommunications cables:
        i. Circuits Under 5kVA: 2” minimum separation.

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ii. Circuits Over 5kVA: 6” minimum separation.

iii. Electrical motors/transformers: 48” minimum separation.

iv. Lighting ballasts: 6” minimum separation.

c. Where telecommunication cable is installed in cable tray or underground in non-metallic conduit near power cables, the power cables shall be kept physically separated from telecommunications cables by a minimum of 12”

F. EF/ER/TR Power Requirements:

1. General: Regardless of what is shown on drawings, the minimum requirements for providing power in the EF/ER/TR are as follows and shall be included in bid:

a. Two dedicated, nonswitched 120V/20A duplex receptacles, each on individual branch circuits at each rack, mounted on the side of the cable tray.

b. 120V/20A Duplex receptacles located +6” A.F.F. placed at 6 foot intervals around perimeter walls. Up to 10 receptacles may be placed on a single circuit.

G. Firestopping and Smoke/Acoustical Pathways(See Also Division 7):

1. Provide firestop/smoke barrier solution equivalent to the wall/ceiling/floor rating.

2. Provide firestop labels next to each penetration with written date. Label both sides of the penetration.

3. Firestop systems shall be UL Classified to ASTM E814 (UL 1479). A drawing showing the proposed firestop system shall be provided to the Engineer prior to installing the Firestop system(s).

4. Utilize firestop pass-through type devices for medium to large penetrations into fire walls/floors.

5. Provide a minimum of (4) 4” trade size Hilti Speedsleeves (or STI EZPath) with at least one spare for each and every firewall penetration where cable tray meets the wall.

6. Provide the following products:

a. Fire Rated; STI EZ-Path Fire-Rated Pathways Series (or Hilti Speed Sleeve CP 653 BA)

b. Smoke/Acoustical Rated; STI EZ-Path Smoke & Acoustical Pathway Series (or Hilti Smoke and Acoustic Sleeve CS-SL SA)

H. Miscellaneous Equipment:

1. Arrange all terminal blocks in a manner that allows natural wiring progression and minimizes crossing of wires.

2. Provide patch cords and cross connect cables as necessary for a complete operational telephone and data network system. Consult with owner to determine any special needs such as dedicated phone lines.

PART 4 – LABELING

4.1 GENERAL

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and

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patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All telecommunications spaces, pathways, cables, connecting hardware, equipment, racks, patch panels, outlet/connectors, and grounding system shall be labeled in accordance with TIA/EIA 606-A.

C. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten, Ink, or Laser Printing labels are not allowed. Provide labels using thermal transfer print. Heat shrinking or wraparound labels are required, flag style labels are not allowed.

4.2 TELECOMMUNICATION PATHWAYS

A. Identify each dedicated pathway (including inner ducts) for the voice and data system.

B. Label pathways at regular intervals and wherever they are accessible.

4.3 TELECOMMUNICATION CABLES

A. Identify cables at each end with a permanent label or physical/electronic tag.

1. The same alphanumeric identifiers should be used at both ends of the cable.

2. Identify cables at regular intervals throughout and wherever they are accessible.

3. Cables shall be identified in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate that can be accessed by removing the cover plate and to the cable behind the patch panel on a section of cable that can be viewed without removing the bundle support ties. Cables labeled within the bundle where the label is obscured from view shall not be acceptable.

4.4 CONNECTING HARDWARE

A. Identify connecting hardware items (termination blocks, cross-connects, racks, cabinets, patch panels, telecommunications outlet/connectors, ports) using alphanumeric identification such as the following three-level scheme:

1. First level—Termination field or patch panel. Color-coding or other labeling should be used to uniquely identify each termination field (e.g., voice and data) on a common mechanical assembly.

2. Second level—Terminal block within a given field or patch panel that could be a row of insulation displacement connectors (IDCs), optical fiber connectors, or modular jacks.

3. Third level—Defines the individual position within a given terminal block or patch panel.

4.5 TELECOMMUNICATIONS GROUNDING SYSTEM

A. Identify each telecommunications grounding bus bar (TGB) and telecommunications main grounding bus bar (TMGB).

B. Identify each grounding conductor relating to the telecommunications system, including those connecting building steel, grounding electrodes, water pipes, and telecommunications structural components.

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PART 5 - MISCELLANEOUS

5.1 TESTING:

A. General

1. Provide testing within 10 days of completion for all copper and fiber optic cable according to TIA/EIA standards and any other requirements of the manufacturer who will provide warranty.
2. Submit copy of current calibration of all testing equipment. Submit all test reports electronically to architect/engineer and include in O&M manuals to include test reports. Meter shall have been calibrated within the past 12 months.
3. Correct any malfunctions. Contractor shall re-terminate/replace any cable, connection, or equipment found to be defective or non-compliant with these specifications and referenced standards.
4. Invite Owner IT representative and Engineer to witness and/or review field testing. Notify five business days prior to commencing testing.

B. Copper Cable

1. Utilize Level IIIe, IV, V Tester to test all equipment and each outlet, horizontal cable, termination block, patch cords, etc. to verify compliance with requirements. Testing shall consist of industry accepted verification tests for the Category of cable installed and shall meet latest requirements of EIA/TIA cabling Standards.
2. UTP Cable and Links: All UTP cabling channel must be tested at swept frequencies up to 250MHz for internal channel performance parameters as defined in IEEE 802.3an and ANSI/TIA/EIA-568C. Certifications shall include the following parameters for each pair of each cable installed:
    a. Wire map (pin to pin connectivity)
    b. Length
    c. Insertion Loss
    d. Near End Crosstalk (NEXT)
    e. Attenuation to Crosstalk Ratio Far End (ACRF)
    f. Return Loss
    g. Propagation Delay
    h. Delay Skew
    i. DC Loop Resistance
    j. DC Resistance Unbalance
    k. Power Sum Near-End Crosstalk (PS-NEXT)
    l. Attenuation to Crosstalk Ratio Near-End (ACR-N)
    m. Power Sum Attenuation to Crosstalk Ratio Near-End (PS-ACR-N)
    n. Attenuation to Crosstalk Ratio Far-End (ACR-F)
    o. Power Sum Attenuation to Crosstalk Ratio Far-End (PS-ACR-F)
    p. Transverse Conversion Loss (TCL)
    q. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
3. All channels that fail testing parameters will be replaced at the Contractor’s expense until all channels pass the performance parameters.

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4. Provide Modular Plug Terminated Link (MPTL) test for all field terminated plugs (standard for cameras and WAPs).
    a. All installed cabling modular plug terminated links (MPTL) shall comply with the permanent link transmission requirements of the ANSI/TIA-568-2.D standard.
    b. The MPTL shall be tested with a Permanent Link Adapter on the Main Unit and a Patch Cord Adapter Suitable for Category 6A testing on the Far End or Remote Test Equipment.
    c. Modular plug terminated link test results, including the individual frequency measurements from the tester, shall be recorded in the test instrument upon completion of each test for subsequent uploading for reports to be generated.
5. Sampling is not acceptable. MPTL testing shall be performed on each cabling segment (connector to connector).

C. Fiber Optic Cable
1. Provide test results using an OTDR of all installed fiber optic links to demonstrate compliance with requirements. Testing shall consist of industry accepted verification tests for the type of cable installed and shall meet the latest requirements of EIA/TIA 455-53A standards. Test setup and performance shall be conducted in accordance with ANSI/TIA/EIA 526-14 Standard Method B.
2. Provide inspection of fiber end faces by using scope and test according to IEC 61300-3-35 standards. Correct scratched, pitted, or dirty connectors.
3. Provide bi-directional testing of cable for both cable rated wavelengths. Results shall show compliance of cable and shall include the following parameters:
    a. Attenuation
    b. Length
    c. Verification of Polarity

D. Owner reserves the right to hire an independent testing company to spot check the test results. If the results vary more than 10% from the results provided by the Contractor, the Contractor will be required to prove his results are correct or retest the entire system.

5.2 WARRANTY:

A. Register installation with cable/connectivity manufacturer.

B. Provide and submit all test results to owner, engineer, and manufacturer and meet all other manufacturer requirements in order to provide minimum 20-year extended product link warranty for complete cabling/connectivity installation, <u>including all copper and optical fiber utilized on the entire channel</u>. The channel warranty shall be provided by the connectivity manufacturer. Include replacement material and installation for any defective product.

5.3 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

5.4 TRAINING:

A. Provide four hours training on the operation and installation of the structured cabling system at job site, at no cost to owner.

5.5 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 1500

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SECTION 27 4100

AUDIOVISUAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Refer to specification 26 0553 for conduit and junction box color requirements.

D. Refer to specification 27 1500 for category and/or optical fiber cable and connectivity specifications.

E. All unshielded category 'UTP' and/or optical fiber cable, for AV equipment, used on this project, shall match the horizontal cabling within the building.

1. Category cables used for transporting video, audio and controls simultaneously from transmitters to receivers and/or switchers shall follow the Manufacturer's recommend cabling specifications.

1.2 ADMINISTRATIVE REQUIREMENTS:

A. BNA Project Contact:

1. Joe Morris, CTS-D
   a. Phone: 801-532-2196
   b. Email: jmorris@bnaconsulting.com
2. Jaime Verhaal, CTS-D, RCDD
   a. Phone: 801-532-2196
   b. Email: jverhaal@bnaconsulting.com

B. Bid Submittal:

1. Equipment Costs: Breakout cost of material and labor as different line items. Refer to bid form for breakout cost requirements.

C. Coordination:

1. Coordinate final inspection of the systems installed, with Audiovisual (AV) Consultant, three (3) weeks in advance.
2. Obtain GANTT chart for construction time frame from the General Contractor.
3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted AV equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted AV equipment in each area.
4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.
5. Meet with Electrical contractor prior to pathway rough-in to coordinate AV system requirements in each area.
6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all AV network requirements. Coordinate cable color according to specification 26 0553.

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7. Meet at least twice with owner and programmer to coordinate AV network requirements. Hold the first meeting after submittal of shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to AV system deployment.
8. Coordinate color and finish of all AV system components with Architect or Electrical contractor as appropriate.
9. Coordinate all AV system components within millwork/furniture with millwork shop drawings prior to rough-in.
10. Coordinate color (including custom color) and finish of all AV system components with Architect prior to ordering. Architect may require custom color of grills, face plates, etc. AV contractor shall paint or have devices painted by others. The cost for custom colors shall be within the AV Contractors Bid.
11. Notify AV Consultant when rough-in is complete and ready to inspect. AV Consultant and Electrical Engineer to sign off on rough-in prior to rough-in resuming rough-in for typical rooms.

D. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.

E. AV contractor shall participate in a mandatory pre-construction meeting no more than sixty (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating the meeting. The meeting will be held at the AV Consultant's office. All submittals, shop drawings and bills of materials shall be completed and submitted to AV Consultant for review eight (8) working days prior to this meeting.

F. AV contractor shall attend the electrical pre-construction meeting per specification 26 0500.

1.3 DESCRIPTION OF WORK:

A. Provide the specified systems in a complete and operating condition with all necessary materials and labor to fulfill the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components. Contractor shall furnish all cables, materials and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

B. Master quotes do not relieve contractor from preforming due diligence for equipment type, equipment quantity, and quantity of room types. Any errors, conflicts, or omissions between the drawings and/or specifications and master quotes shall be the responsibility of the contractor to resolve.

C. Bidders wishing to provide equipment other than the equipment specified shall submit proposed substitute equipment to AV Consultant eight (8) working days prior to bidding. Submittals for prior approval shall include description of equipment, design intent, complete riser diagrams for proposed equipment, equipment specifications, cut sheets of proposed equipment, reason for alternate equipment. AV Consultant may request physical equipment to test and demo. Acceptance of proposed equipment by AV Consultant shall not relieve AV contractor from responsibility to provide audio-visual systems equal to those specified in this Section. Contractor shall be ultimately responsible for providing complete and working audio-visual systems that function, control and operate in the same manner as the specified equipment. AV Consultant has final say if proposed equipment is equal to the specified equipment. Equipment that AV Consultant is not familiar with will require the contractor to provide manufacturer training at manufacturer's facility and have a manufacturer representative present at time of commissioning.

1. Refer to section 2.2 for approved equals of basis of design equipment.

D. Equipment submitted in the bid proposal that has not been approved by AV Consultant in writing will not be accepted and shall be replaced by approved equipment at contractors'

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expense. Equipment not listed within this specification, or contract documents, that is required for a complete and working system, shall be of professional grade, new and used in the same manner as needed for a complete and working system.

E. Input plates shall match the color and style being used throughout the project.

F. All control processors, controllers, DSPs, and Network Switches are to be on an unswitched power connection and connected to an uninterrupted power supply.

1.4 DEFINITION OF TERMS:

A. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's applications and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.

B. Configure: The term "Configures" or “Configuration” is used to describe set up of components which includes menu based settings, image alignment, dip switches, setup wizards, EDID, etc. required for standard functionality.

C. Contractor: the term “Contractor” refers to the company contracted to perform the work within this specification and associated documents.

D. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.

E. Furnish, Install, and Provide: Refer to 26 0500 for definition.

F. General: Basic Contract definitions are included in the General Conditions.

G. Graphical User Interface (GUI): The term “Graphical User Interface (GUI)” is used to describe the user interface from a touch screen. This is a custom interface provided with the programming of the system.

H. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

I. Installer: An "Installer" is the Contractor, or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

J. Programming: The term “Programming” is used to describe writing computer code or a sequence of logic to perform an operation from a triggering event. Programming will be installed on a control processor or similar platform identified within the documents.

K. Programmer: the term “Programmer” is the company or entity engaged by the programming company, either as an employee, subcontractor, or sub-subcontractor, for providing the programming services.

L. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

M. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions."

1.5 QUALITY ASSURANCE:

A. Installer:

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1. Integrating firm shall have worked satisfactorily for a minimum of five (5) years of completing systems equal to this scope, quality, type and complexity.
2. Key personnel assigned to the project shall each have minimum of ten (10) years of experience in completing systems equal to this scope, quality, type and complexity.
3. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
4. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
5. Contractor shall have current manufacturer certificates for all AV systems and equipment listed within this specification.
6. Contractor shall be in good standing with the owner.
7. Contractors that do not meet the above requirements cannot bid on this project.

B. Contractor must follow the standards described within:

1. BICSI/AVIXA AV Design Reference manual.
2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.

C. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.

D. PRE-APPROVED INSTALLERS:

1. AVI-SPL
2. Cache Valley Electric
3. Ford AV
4. GenComm
5. Hunt Electric
6. LINX
7. Performance Audio
8. Poll Sound
9. Summit Fire
10. TPI
11. TVS Pro
12. Wasatch Electric
13. WEBB AV
14. Bids submitted by non-approved installers will not be accepted.
15. Bidders not pre-approved shall submit in writing the following for review at least eight (8) working days prior to bid:
    a. List of qualifications including:
        i. Industries certifications including manufacturers.
        ii. Approved resale manufacturers.
    b. Past and current projects within the last five (5) years similar in scope and size.
    c. Three (3) Different referrals from the owners of three (3) different projects within the last five (5) years.

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1.6 SUBMITTALS: Refer to specification 26 0502 for shop drawing submittal requirements.

1.7 WARRANTY:

A. Systems shall be guaranteed for a period of one (1) year from the date of substantial completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor, etc. required to maintain the functionality at the time of system completion.

1. System completion shall be signed off by the programmer, contractor, and the owner. At that time the system will be considered complete.

B. If system failure causes the audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair the system to be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.

C. At the final sign off with the owner, AV Consultant, and AV Integrator the programing source code will be turned over to the contractor for them to maintain and owner during the warranty period. The Programmer will be available during the warranty period for questions on the source code but shall not be responsible for maintaining or modifying the code after substantial completion.

1. The contractor shall utilize their existing service department for warranty calls. Trouble shooting of system components shall be performed before adjustment to the programing is required.

D. Programming warranty includes the following:

1. Lighting control: limited to 1 change after completion sign off. AV system integration is limited to only recalling presets. Refer to section 3.1.K for lighting integration requirements. GUI: limited to button rearrangement.

2. Manufacturer defective equipment shall be reprogrammed as needed.

a. If temporary equipment is needed in the interim, it shall be programmed by the AV contractors inhouse team as part of the warranty.

E. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

PART 2 – PRODUCTS

2.1 GENERAL:

A. All equipment shall be installed as shown on the drawings and in strict accordance with the specifications. Any errors, conflicts, or omissions discovered in the specifications or the drawings shall be submitted in writing to the AV Consultant for clarification.

B. Equipment lists are provided to identify quality and functional expectations. They may not be complete. Coordinate with devices shown on drawings, system risers and equipment lists for system intent. Provide a complete and functional system as described within the construction documents.

2.2 MANUFACTURER APPROVED EQUALS:

A. The Manufacturers listed below have the potential to be considered equals, as it relates to the system design intent and the equipment specified herein. Refer to section 1.3.C. for substitution requirements. Any equipment chosen as equal to what has been specified in section 2.4 will be the responsibility of the AV Integrator to coordinate all resulting changes and guarantee a complete and functional system e.g. rough-in requirements, programming, etc. Please note that some components have been chosen over others for

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features and/or size limitations. Equipment listed below with an asterisk have feature and/or size limitations and may not be substituted.

1. Amplifiers – Ashly, Crestron, Crown, Extron, Lab Gruppen, LEA Professional, Powersoft, QSC and StewartAudio
2. Assisted Listening Systems – Listen Technologies, Williams AV
3. Cables – Belden, Crestron, Extron, Gepco/General, Ice, Kramer, Liberty, and Westpenn cables
4. Controls – AMX, Crestron and Extron
5. Displays – LG, NEC, Planar, Panasonic, Samsung, Sharp, and Sony
6. DSPs – Biamp, BSS, Extron, QSC and Symetrix
7. Equipment racks – AtlasIED, Chief, Lowell and Middle Atlantic
8. Loudspeakers – AtlasIED, Bose, Community, JBL and SoundTube
9. Microphones – AKG, Audio Technica, Audix, Lectrosonics, Sennheiser and Shure
    a. Auditorium wireless microphones alternates are not acceptable.
10. Mounts – Chief and Premier mounts
11. Network equipment – Cisco, Luxell, and Netgear
12. Networked Audio – Attero tech (QSC), Extron, and RDL
13. Projection Screens – Da-Lite, Draper and Stewart Filmscreen
14. Video Equipment – AMX, Crestron, and Extron
15. Wall plates – Attero tech (QSC), Crestron, Extron, RCI Custom, Liberty Panelcrafters and RDL

2.3 GENERAL EQUIPMENT REQUIREMENTS:

A. The equipment specified in this document aims to fulfill the intended functional requirements by precisely identifying the necessary equipment. Depending on the timing of component orders and the project timeline, there may be instances where certain equipment needs to be replaced with newer models. In the event that the indicated equipment is unavailable or has been replaced, the supplier or contractor shall provide a new model that offers comparable functionality.

B. Loudspeakers:

1. Provide applicable mounting equipment as needed, including but not limited to; back boxes, mounting hardware, safety equipment, and seismic restraints.

C. Video Signal:

1. The equipment listed below is considered to be equal replacement parts for a point-to-point video solution as it relates to the system design intent. Equipment listed in section 2.4 override the equipment listed below.
    a. Cable Equalizer for cable lengths exceeding 30’ but no more than 75’ or that have more than two (2) union connections. Connect to external power supply and do not use the 5 volts within the HDMI cable.
        i. Extron – HD 4K 101 Plus or Kramer – PT-3H2
    b. Point to point HDBaseT extension, 18 Gbps, 4k60 4:4:4 at 100 Meters:
        i. Crestron – DM-TX-4KZ-100-C-1G with DM-RMC-4KZ-100-C. or Extron – DTP2 T 211 with DTP2 R 211.
2. HDMI cables intended for client device connection and that are less than 15’ shall be a flexible cable and support 18 Gbps, 4k60 4:4:4 for the entire length of the cable.

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3. Equipment that is not preapproved by the AV Consultant in writing will not be accepted and will be replaced with the approved equipment at no cost to the Owner.

D. Audio Signal:

1. The equipment listed below is considered to be equal replacement parts for a point-to-point video solution as it relates to the system design intent. Equipment listed in section 2.4 override the equipment listed below.

a. Passive or Active audio summing adapter. Extron – ASA 131 or RDL – STA-1

b. Isolation transformer: RDL – EZ-HK1

E. Cables grouped together shall be dressed in expandable nylon loom, similar to Techflex - Flexo

F. Provide virtual touch panel for windows, and/or Mac, controller for full control of the system.

1. Virtual touch panel shall be able to mimic every Touch Panel in the system, and give full control over the touch panel in each room.

2. Virtual touch panel shall be password protected and used for tech support only within the company.

G. Equipment Racks:

1. All AV equipment racks within this specification shall have the following accessories and/or features, either rack mountable or built into the rack, depending on the model of the rack. Refer to bid documents for all rack mounted equipment. Provide the following accessories as referred to in elevations. RUs are indicated in the elevations and noted with a # symbol in the part number.

2. General Equipment

a. Shelving: Middle Atlantic – SS; 1RU shelf.

b. Drawers:

i. Nonlocking: Middle Atlantic – D#

ii. Locking: Middle Atlantic – D#LK

c. Header panel, located at the top of the rack, AV contractor to submit their logo to RCI for inclusion in the Header panel. If AV contractor has another company that makes the Header panel, provide that information to the AV Consultant.

i. RCI Custom – BNA001-200120MM-01

d. Blank plates: Middle Atlantic – EB#

e. Surge protection for all devices located within the rack. Surge protector shall be: 20 AMPs, rack mountable or mount to a side rail and at least 1,000 joules of protection.

i. Recommended Surge protector is Middle Atlantic – PD-920R-SP. Additional acceptable manufacturers are: Furman, Juice Goose, Tripplite and SurgeX.

f. Horizontal, vertical, and entry cable management.

i. All cabling shall be straight off of the back of equipment to horizontal supports connected to equipment rack. Cabling shall follow support to vertical supports when going into other components and/or out of the equipment rack.

ii. Cabling secured to other cabling and supported from the connector is not acceptable.

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iii. Separate AC power and other signal types from each other.

g. Provide 20 Amp rated power strips as necessary.

h. Sequencers:

i. Provide a Middle Atlantic – PDS-620R or Furman – CN-2400S Sequencer.

ii. All equipment racks with the following equipment shall have a sequencer within the equipment rack. AV integrator to follow industry standards when using sequencers.

1. Amplifiers
2. Video processors without control processors
3. Wireless Mics

i. Uninterrupted power supply (UPS)

i. Provide a Middle Atlantic – UPX-RLNK-1500R-2 UPS.

ii. All equipment racks with the following equipment shall have a UPS within the equipment rack.

1. Video Processors
2. DSP
3. Network Switches
4. Control Processors

j. Passive Thermal Management

i. Vented rear door with no less than 60% open area.

ii. Solid blank panels on the front of the rack in all unused rack spaces.

iii. Stack power amplifiers without open rack space between.

iv. Top of equipment cabinet to be open or vented.

v. Provide passive thermal management in all racks unless noted above.

2.4 EQUIPMENT REQUIRED PER ROOM TYPE

AV SYSTEMS PROGRAMMING			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
	AV SYSTEMS PROGRAMMING ALLOWANCE REFER TO SECTION 3.3 FOR SCOPE OF PROGRAMMING	BNA CONSULTING	$19,800.00 SYSTEMS PROGRAMMING ALLOWANCE
END OF SCHEDULE			

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BUILDING EQUIPMENT SCHEDULE			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
T	FLAT PANEL TILT MOUNT, 14°, MAX 250LBS LOAD, 1070 X 600 mm VESA, LANDSCAPE	CHIEF	XTM1U
D55	LCD, 55" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 300x300 VESA	SONY	OFCI
	DIGITAL SIGNAGE PLAYER	BRIGHTSIGN	OFCI
END OF SCHEDULE			

TYPICAL CLASSROOM EQUIPMENT SCHEDULE			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
	PROXIMITY COMPONENT STORAGE PANEL	CHIEF	CSSLP15X10
TxH	HDMI + USB-C INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP3 T 212 D (WHITE KEYSTONE PLATES)
Rx	VIDEO RECEIVER, DTP	EXTRON	DTP HDMI 4K 230 RX
CSA 1C	CLASSROOM RF MICROPHONE SYSTEM, RF RECEIVER, TEACHER & HANDHELD MICROPHONE, NO LOUDSPEAKERS	LIGHTSPEED	CASCADIA C25 (OFCI)
	MEDIA DEVICE	APPLE	APPLE TV (OFCI)
KP2	KEYPAD, 4 BUTTONS WITH VOLUME KNOB	EXTRON	MLC PLUS 100
1B	POWER AMPLIFIER 2 CHANNEL X 100 WATTS, 4 Ohms	EXTRON	XPA 1002
C4	LOUDSPEAKER, 6", CEILING, LOW PROFILE 120 DEGREE COVERAGE	LIGHTSPEED	DRQ
T	FLAT PANEL TILT MOUNT, 14°, MAX 250LBS LOAD, 1070 X 600 mm VESA, LANDSCAPE	CHIEF	XTM1U
D85	LCD, 85" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 400x400 VESA	SONY	OFCI
HD	HDMI CABLE, 6', 18 Gbps, 4K60 4:4:4	EXTRON	HDMI ULTRA/6
HD	HDMI CABLE, 50', PLENUM RATED HIGH SPEED OPTICAL CABLE	EXTRON	HDMI PRO P/50
END OF SCHEDULE			

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MUSIC ROOM EQUIPMENT SCHEDULE			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
	PROXIMITY COMPONENT STORAGE PANEL	CHIEF	CSSLP15X10
TxH	HDMI + USB-C INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP3 T 212 D (WHITE KEYSTONE PLATES)
Rx	VIDEO RECEIVER, DTP	EXTRON	DTP HDMI 4K 230 RX
CSA 1C	CLASSROOM RF MICROPHONE SYSTEM, RF RECEIVER, TEACHER & HANDHELD MICROPHONE, NO LOUDSPEAKERS	LIGHTSPEED	CASCADIA C25 (OFCI)
	MEDIA DEVICE	APPLE	APPLE TV (OFCI)
BT	BLUETOOTH, 1-GANG WALL PLATE WITH RECEIVER	RDL	DB-BT1A TX-TPR3A
KP2	KEYPAD, 4 BUTTONS WITH VOLUME KNOB	EXTRON	MLC PLUS 100
1A, 1H	POWER AMPLIFIER 2 CHANNEL X 350 WATTS, 4 Ohms - 70/100V	LEA PROFESSIONAL	CONNECT 352
C7	LOUDSPEAKER, 6", CEILING TWO-WAY, 120 DEGREE COVERAGE	JBL	CONTROL 47C/T
T	FLAT PANEL TILT MOUNT, 14°, MAX 250LBS LOAD, 1070 X 600 mm VESA, LANDSCAPE	CHIEF	XTM1U
D85	LCD, 85" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 400x400 VESA	SONY	OFCI
HD	HDMI CABLE, 6', 18 Gbps, 4K60 4:4:4	EXTRON	HDMI ULTRA/6
HD	HDMI CABLE, 50', PLENUM RATED HIGH SPEED OPTICAL CABLE	EXTRON	HDMI PRO P/50
END OF SCHEDULE			

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MEDIA CENTER EQUIPMENT SCHEDULE			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
R3	EQUIPMENT RACK, ABOVE CEILING 4 RU, RECESSED	FSR	CB-224S
	PROXIMITY COMPONENT STORAGE PANEL	CHIEF	CSSLP15X10
	TWO CHANNEL AUDIO BALANCED AND UNBALANCED CONVERTER	EXTRON	BUC 202
TxH	HDMI INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP T HWP 4K 231 D
Tx	HDMI INPUT WITH DTP TRANSMITTER	EXTRON	DTP HDMI 4K 230 Tx
CSA 1C	CLASSROOM RF MICROPHONE SYSTEM, RF RECEIVER, TEACHER & HANDHELD MICROPHONE, NO LOUDSPEAKERS	LIGHTSPEED	CASCADIA C25 (OFCI)
	WIRELESS COLLABORATION DEVICE	EXTRON	SHARELINK PRO 1100
	MEDIA DEVICE	APPLE	APPLE TV (OFCI)
NS	NETWORK SWITCH, MANAGED, PoE+, 125W (8) 1GB POE+ AND 2X1G +2SFP PORTS	NETGEAR	M4250-10G2F-POE+
TP7	TOUCH PANEL, 7" DIAGONAL	EXTRON	TLP PRO 725M BB 710M (BACK BOX)
	VIDEO SWITCHER, MATRIX 8 INPUT, 2 OUTPUT 4K W/CONTROL PROCESSOR STEREO AMPLIFIER AND AV VLAN	EXTRON	DTP CROSSPOINT 82 4K IPCP SA
1M	POWER AMPLIFIER 2 CHANNEL X 400 WATTS, 70 V	EXTRON	XPA 4002 70V
P5	LOUDSPEAKER, 6", PENDANT 135 DEGREE COVERAGE, 88dB, 70V/16Ω BYPASS	QSC	AD-P6T
T	FLAT PANEL TILT MOUNT, 14°, MAX 250LBS LOAD, 1070 X 600 mm VESA, LANDSCAPE	CHIEF	XTM1U
D85	LCD, 85" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 400x400 VESA	SONY	OFCI
HD	HDMI CABLE, 6', 18 Gbps, 4K60 4:4:4	EXTRON	HDMI ULTRA/6
END OF SCHEDULE			

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CONFERENCE ROOM EQUIPMENT SCHEDULE			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
	PROXIMITY COMPONENT STORAGE PANEL	CHIEF	CSSLP15X10
Tx	4K/60 HDMI DTP3 TRANSMITTER	EXTRON	DTP3 T 203
Rx	VIDEO RECEIVER, DTP	EXTRON	DTP HDMI 4K 230 RX
US	4-PORT USB 3.1, 100M CAT6A/7 EXTENDER SYSTEM W/OPTIONAL MOUNTING KIT	ICRON	RAVEN 3104 W/OPTIONAL MOUNTING KIT
FB1	FURNITURE BOX 1 WITH RJ-45 CAT6 PUNCH DOWN, HDMI RETRACTOR, USB-C VIDEO RETRACTOR, USB 3.2 RETRACTOR, AND RETRACTOR BRACKET	EXTRON	CABLE CUBBY 202 (BLACK) 60-1927-02 70-314-17 70-1065-03 70-1065-04 70-1043-02 70-1065-56 70-1065-06
CS	WIRELESS COLLABORATION SYSTEM INCLUDES RECEIVER AND ONE BUTTON TRANSMITTER	BARCO	CLICKSHARE C-10
	MEDIA DEVICE	APPLE	APPLE TV (OFCI)
	HDMI SWITCHER, 4 INPUT 1 OUTPUT	EXTRON	SW4 HD 4K PLUS
T	FLAT PANEL TILT MOUNT, 14°, MAX 250LBS LOAD, 1070 X 600 mm VESA, LANDSCAPE	CHIEF	XTM1U
D85	LCD, 85" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 400x400 VESA	SONY	OFCI
SB1 TC8	UC SMART SOUNDBAR W/INTEGRATED CAMERA, MICORPHONES AND STEREO SPEAKERS, SMALL/MEDIUM ROOM UP TO 25 PICKUP RANGEINCLUDES TABLE TOP CONTROL TOUCHPANEL	POLY	POLY STUDIO X70 WITH POLY TC8 TABLE TOP TOUCHPANEL
	OWNER PC	OWNER	OFOI
END OF SCHEDULE			

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TYPICAL OFFICES & RESOURCE EQUIPMENT SCHEDULE			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
HD	HDMI INPUT, WALL PLATE W/ STEREO AUDIO & CONTROL	EXTRON	WPD 110 A
TxH	HDMI INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP T HWP 4K 231 D
	MEDIA DEVICE	APPLE	APPLE TV (OFCI)
T	FLAT PANEL TILT MOUNT, 14°, MAX 200LBS LOAD, 878 X 500 mm VESA, LANDSCAPE	CHIEF	LTM1U
T	FLAT PANEL TILT MOUNT, 14°, MAX 250LBS LOAD, 1070 X 600 mm VESA, LANDSCAPE	CHIEF	XTM1U
D60	LCD, 60" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 300x300 VESA	SONY	OFCI
D75	LCD, 75" DIAGONAL, 4k, 16/7 OPERATION, 350 NIT, HDCP 2.3, 1-COMPOSITE VIDEO, 3-HDMI, 1- ANALOG AUDIO, 1-DIGITAL AUDIO, 2-USB, 1-LAN, 300x300 VESA	SONY	OFCI
HD	HDMI CABLE, 6', 18 Gbps, 4K60 4:4:4	EXTRON	HDMI ULTRA/6
HD	HDMI CABLE, 35', PLENUM RATED HIGH SPEED OPTICAL CABLE	EXTRON	HDMI PRO P/35
END OF SCHEDULE			

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MULTIPURPOSE ROOM EQUIPMENT SCHEDULE (1 OF 2)			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
R2	EQUIPMENT RACK, WALL MOUNT 61" TALL, 22" DEEP, 35 RU WITH VENTED FRONT DOOR	MIDDLE ATLANTIC	DWR-35-22 WITH LVFD-35
	SHELF, PULL OUT, RACK MOUNT LATCHING, 1 RU	MIDDLE ATLANTIC	SS
	DRAWER, PULL OUT, RACK MOUNT LATCHING, 2 RU	MIDDLE ATLANTIC	D2
	DRAWER, PULL OUT, RACK MOUNT LATCHING W/LOCK, 4RU	MIDDLE ATLANTIC	D4LK
	BLANK AND VENT PANELS AS REQUIRED	MIDDLE ATLANTIC	BL# SERIES VTP-# SERIES
	BRUSH GROMMET PANEL, 1RU	MIDDLE ATLANTIC	BR1
	BNA LOGO BLANK PANEL, 1RU WITH RJ45 KEYSTONE JACK FOR SERVICE PORT AND PATCH CABLE TO ETHERNET SWITCH	RCI CUSTOM	BNA001-200120MM-01
	SURGE PROTECTOR	MIDDLE ATLANTIC	PD-920R-SP
	SMART SEQUENCING POWER CONDITIONER, 15A, 9 OUTLETS	FURMAN	CN-1800S
TxH	HDMI INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP T HWP 4K 231 D
Rx	VIDEO RECEIVER, DTP	EXTRON	DTP HDMI 4K 230 RX
	MEDIA DEVICE	APPLE	APPLE TV (OFCI)
WMH	WIRELESS HANDHELD MICROPHONE, WIRELESS RECEIVER KIT	SHURE	QLXD24/SM58 QTY: REFER TO PLANS
WMB	MICROPHONE, WIRELESS RECEIVER AND LAVALIER	SHURE	QLXD14/83 QTY: REFER TO PLANS
	RECHARGABLE BATTERY PACK (SHURE - QLXD AND ULXD)	SHURE	SB900B
	8-BAY BATTERY CHARGER (SHURE - SB900B)	SHURE	SBC800-US QTY: 1 PER (8) SB900B
AT	ANTENNA DISTRIBUTION SYSTEM OMNI DIRECTIONAL ANTENNA (2) TOTAL	SHURE	UA860SWB (ANTENNA) UA844+SWB
ALS	ASSISTED LISTENING PRIME LEVEL III STATIONARY RF SYSTEM- 72 MHZ INCLUDING: TRANSMITTER ANTENNA KIT RACK MOUNTING KIT RECEIVERS EAR SPEAKERS NECK LOOP LANYARDS 2M DUAL RCA CABLE 12-UNIT CHARGING TRAY NOTIFICIATION SIGNAGE KIT	LISTEN TECHNOLOGIES	LS-55-072 INCLUDING: (1) LT-800-072-01 W/RACK KIT (1) LA-122 (1) LPT-A107-B (1) LA-381-01 (1) LA-304 (#) LR-4200-072 (PER ADA REQ) (#) LA-401 (PER Rx QTY) (#) LA-430 (PER ADA REQ) (#) LA-423 (PER Rx QTY)

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MULTIPURPOSE ROOM EQUIPMENT SCHEDULE (2 OF 2)			
TYPE	**DESCRIPTION**	**MANFR.**	**MODEL NO.**
M2D	AES-67/DANTE, WALL PLATE, WITH 2 CH INPUT, 2-XLR, 2-LINE INPUTS	QSC	AXON D2i
BT	AES-67/DANTE, 2-GANG WALL PLATE, WITH 4 CH INPUT, BLUETOOTH, L/R-RCA, L/R-3.5mm, 2 CH OUTPUT, L/R-3.5mm	QSC	unD6IO-BT
MXT	AES-67/DANTE, 2-GANG WALL PLATE, WITH 4 CH INPUT, 2-XLR, L/R-RCA, L/R-3.5mm, 2 CH OUTPUT, L/R-3.5mm	QSC	unD6IO
NS	NETWORK SWITCH, MANAGED, PoE+, 480W (40) 1GB POE+ AND +8SFP+ PORTS	NETGEAR	M4250-40G8F-POE+
TP7	TOUCH PANEL, 7" DIAGONAL	EXTRON	TLP PRO 725M BB 710M (BACK BOX)
	VIDEO SWITCHER, MATRIX 8 INPUT, 2 OUTPUT 4K W/CONTROL PROCESSOR STEREO AMPLIFIER AND AV VLAN	EXTRON	DTP CROSSPOINT 82 4K IPCP SA
	UNIFIED CORE WITH 24 LOCAL AUDIO I/O CHANNELS, 128X128 TOTAL NETWORK I/O CHANNELS WITH 8X8 SOFTWARE-BASED DANTE LICENSE INCLUDED, USB AV BRIDGING, DUAL LAN PORTS, POTS AND VOIP TELEPHONY, NO GPIO, 16 NEXT-GENERATION AEC PROCESSORS, 1RU.	QSC	CORE 110F-V2 (INCLUDE UCI AND SCRIPTING LICENSES)
1A, 1H	POWER AMPLIFIER 2 CHANNEL X 350 WATTS, 4 Ohms - 70/100V	LEA PROFESSIONAL	CONNECT 352
1G	POWER AMPLIFIER, DANTE 4 CHANNEL X 700 WATTS, 4 Ohms - 70/100V	LEA PROFESSIONAL	CONNECT 704D
P6	LOUDSPEAKER, 6", PENDANT, HIGH CEILING 75 DEGREE COVERAGE	JBL	CONTROL 67 HC/T WHITE
P8	LOUDSPEAKER, 8", PENDANT SUBWOOFER	JBL	CONTROL 60 PS/T
	PROJECTOR WALL MOUNT, HEAVY DUTY WALL MOUNT, DUAL STUD.	CHIEF	WMA2S
P1	LCD, 7,000 lm, WUXGA w/ENHANCED 4K, LASER, 1-DVI-D, 1-HDMI, 1-HDBaseT, 1-VGA, 3- USB, 1-COM, 1-LAN, 1-AUDIO OUT, 45° V / 30° H LENS SHIFT	EPSON	EB-PU1007X w/ LENS: ELPLW08 (1.18-1.66)
SC1	CEILING, MOTORIZED, 16x10, 226" SCREEN W/DA-TEX MATERIAL	DA-LITE	TENSIONED COSMOPOLITAN 70277
	MICROPHONE, HANDHELD	SHURE	(2) BETA 58A
	MICROPHONE, CABLES	WHIRLWIND	(2) 25' CABLES
	MICROPHONE, CABLES	WHIRLWIND	(2) 50' CABLES
	MICROPHONE STAND	ATLAS IED	(2) MS20E
HD	HDMI CABLE, 6', 18 Gbps, 4K60 4:4:4	EXTRON	HDMI ULTRA/6
END OF SCHEDULE			

PART 3 – EXECUTION

3.1 INSTALLATION OF AV SYSTEMS:

A. Provide AV systems and ancillary equipment as indicated on drawings and in accordance

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with equipment manufacturer's written instructions, the NEC, and with industry best practices.

B. Coordinate all work performed by other contractors pertaining to the AV system, including raceways, electrical boxes and fittings.

C. Video systems.

1. HDCP:

a. All equipment within the signal path must be capable of processing HDCP-compliant material.

b. All switcher, scalers, transmitters, and receivers shall reflect the HDCP compliance of the endpoint/display(s).

c. HDCP shall be disabled in the switcher/scaler when a non-HDCP-compliant endpoint/display is used.

2. EDID Strategy:

a. Permanent video sources shall be set manually within the equipment to output their native resolution. Video properties shall not rely on EDID.

b. Portable video sources and wall plates shall use EDID tables within the switcher/scaler for preferred video properties. The EDID table shall be set with the following settings:

i. Most common resolutions within the display's aspect ratio.

1. 3840 x 2160 (UHD) 60Hz, 4:4:4 Chroma sample

ii. Audio: refer to control section for audio requirements. This will include mono, Stereo, Surround sound, etc.. All audio will be 44,100 Hz, 16 bit unless otherwise noted.

D. Pathway Requirements:

1. General:

a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.

b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Field coordinate alternate pathway requirements with other trades onsite. New pathways shall not exceed distance limitations defined within this specification. Notify the Engineer of the changes for final approval prior to proceeding with the change.

2. Conduits:

a. Contractor shall provide a minimum of 1-1" EMT conduit from device to accessible ceiling space unless otherwise noted. Then utilize non-continuous cable support from devices to connecting device. Refer to AV symbol schedule for specific conduit requirements.

i. Provide non-continuous open top cable supports every 5' above accessible ceiling.

b. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling.

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c. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.

d. Provide large radius elbows on all bends.

e. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.

f. AV conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.

g. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.

h. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.

i. This is a new building. There shall not be any free-hanging cables. No wiremold is permitted throughout the project. Coordinate all rough-in, finishes, etc., with the electrical contractor prior to rough-in installation.

3. Open Top Cable Support Requirements:

a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables

b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

4. Pull Box Requirements:

a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.

b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.

c. Conduits that enter a pull box from opposite ends should be aligned.

d. Pull boxes shall have a length 12 times the diameter of the largest conduit.

e. All pull boxes must be accessible.

E. Cabling System:

1. Follow T568B scheme for copper category cabling terminations.

2. Provide a minimum 6" service loop in each AV system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.

3. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.

4. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

5. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for AV cable is required, the contractor shall install appropriate carriers to support the cabling.

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6. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
7. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
8. Pair untwist at the termination shall not exceed 0.125”. The cable jacket shall be maintained as close as possible to the termination point.
9. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.
10. Group multiple cabling together with expandable nylon loom, similar to Techflex - Flexo, when cabling exists a cavity and connects to a device. Cabling within a lectern, podium or millwork shall have expandable nylon loom sleeve as well.
11. Any cabling or conduit that penetrates through walls shall be sealed with rubber shields and flexible to allow for cabling to be maintained or replaced, as necessary, in the future.

F. Grounding System:

1. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
2. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
3. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
4. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
5. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.
6. Refer to electrical diagrams for additional ground connection requirements.

G. Cabling groups and conduit separation:

1. Refer to “CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE”, located on the drawings

H. Firmly secure all equipment in place that is not intended for portability.

I. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.

J. Provide adequate structural support for AV system components. Provide fastenings and supports with a safety load factor of at least five.

K. Coordinate with lighting control system installer for programming and interface with the AV control system.

1. Coordinate with the lighting control supplier for type of connection required to communicate with the lighting system. Note that lighting controls may not be selected until after bid.

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2. Refer to diagrams, plans and/or lighting control specifications for lighting control requirements within the AV system.
3. Controls shall trigger presets determined by the owner prior to final walk-through. Presets may be changed as indicated in the programming scope of work, at the owner's request.
4. The following system types will require lighting integration:
    a. Multipurpose room

3.2 LABELING

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All AV pathways, cables, connecting hardware, equipment, racks, patch panels, outlet/connectors, and grounding system shall be labeled in accordance with TIA/EIA 606-A.

C. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten, Ink, or Laser Printing labels are not allowed. Labels shall be uniform in physical size and text height with minimal blank space. Provide labels using thermal transfer print. Heat shrinking or wraparound labels are required, flag style labels are not allowed.

D. Provide laminated plans (minimum size 11x17) of all AV as-built plans (including one-line diagrams) in each and every AV Rack.

E. Label each equipment with the date (month/year) that it was installed along with the IP address, if applicable, and equipment type.

3.3 CONTROL SYSTEM FUNCTIONALITY:

A. GENERAL:

1. The control processing and digital signal processing programming required for AV sub-systems as defined in section 2.4 of this specification shall be completed by BNA Consulting.
    a. The General AV sub-systems require configuration and are not included in BNA's programming scope of work.
    b. Configuring of system components will be part of the Contractors scope of work. Contractor shall provide IP address, MAC address, Serial numbers, etc to BNA for coordination with the program.
    c. IP address will be coordinated by the programmer and shared with contractor for implementation into specific devices.
    d. If the contractor chooses to provide their own programming services, it must match the functional intent as defined by BNA Consulting exactly. No exceptions.
2. The successful bidder for this specification section (27 4100) shall contract BNA Consulting for performance AV programming services.
    a. The allowance defined in section 2.4 for the performance AV systems programming services shall be included in the bid as a line item.
    b. Contracting shall take place once shop drawings are submitted. The

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Programming phase shall begin upon final review of AV contractor shop drawings.

3. Control programs & DSP configuration programs shall be designed to match the schematic system wiring as shown in approved shop drawings.
4. The AV contractor must field wire each system in accordance with the final reviewed shop drawings.
    a. Any deviations made to shop approved shop drawings will be subject to additional programming service fees.
5. Before programming services commence, the AV contractor shall confirm that all connections are complete, and all equipment is powered up and functional.
    a. Written documentation including site progress photos shall be provided to BNA Consulting prior to commencement of the programming phase.
6. Bluetooth device in gymnasium shall have pin code assigned.

B. CONTRACTOR SCOPE OF WORK:

1. Configuration:
    a. The following is expected to be complete prior to implementation of the program. Testing of the system settings shall be confirmed by the installer.
    b. Component Configuration requirements:
        i. Setup wizard is complete and ready for functionality.
        ii. Image set to Dot to Dot and aligned with the screen surface.
        iii. Device controls are set as identified in the signal flows ie: RS-232, IR, Relay, Contact, or IP controls.
        iv. Limit settings on screens, shades, etc..
        v. Turning off ECO mode.
        vi. Dip switches, dials, and manual settings on devices.
        vii. Device network settings, IP Static/DHCP, Domain, Subnet, etc.
            1. These will be provided by the programmer for the AV installer to configure prior to implementation of the program.
            2. Network connection and power for devices are expected to be ready for testing.
            3. IGMP for Dante/QES-67 settings
            4. QOS Settings to match traffic requirements
        viii. Configuration of the Controller processor/controlling device will be by the AV programmer in the AV installers local facility.
    c. Coordinate with the programmer on programming testing prior to installation.

C. PROGRAMMER SCOPE OF WORK:

1. The Programmer shall be responsible for providing programming services for the following systems. All other systems not specifically mentioned below shall be covered by the contractor.
    a. Multipurpose room / Gym
    b. Auditorium

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c. LIST ROOMS/SYSTEMS HERE THAT THE PROGRAMMER WILL BE WORKING ON.

2. The Programmer check list shall be complete prior to the programmer arriving to the site, anything that is not completed when the Programmer arrives will result in an additional site charge covered by the AV Contractor.

3.4 CYBER SECURITY

A. Contractor shall change all default username and passwords for all network devices provided. A Strong Password should include at a minimum the following:

1. Be at least 12 characters in length
2. Contain both upper and lowercase alphabetic characters (e.g. A-Z, a-z)
3. Have at least one numerical character (e.g. 0-9)
4. Have at least one special character (e.g. ~!@#$%^&*()_-+=)
5. Cannot contain full words

B. No written username or passwords shall be located in any areas of installation.

C. Network devices to be set up on a separate network other than owner's LAN ensuring no internal or external users can access system without authorization.

D. Follow manufacturers hardening guide and use best industry practices to secure network and devices provided by contractor and associated with system.

3.5 FIELD QUALITY CONTROL:

A. TESTING:

1. Refer To Section 27 4101 For Additional Requirements.

B. At the time of final commissioning, if the AV consultant determines that the systems are not sufficiently complete to do a final punch list, and was not notified at least three (3) days prior to the visit, then a return visit will be required. The AV Consultant's return visit will be paid for in advance by the AV integrator at a flat rate of $3,000 per person, at no cost to the owner.

3.6 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

3.7 TRAINING:

A. Provide four (4) sessions of two (2) hours each of training on the operation of each system, at job site, at no cost to owner. Systems shall be complete and have been finalized by the AV Consultant prior to training.

B. Training shall be recorded using a video recording device that support a minimum resolution of 1080P/60 with an integrated microphone connection for an external microphone and a camera tri-pod mount. Presenter shall be wearing a lapel microphone that connects to the recording device and a Tri-pod shall be used for stabilizing the recording device. Recordings that are shaky, poor audio and/or video quality, incomplete, or other issues will not be accepted and the contractor will be responsible for providing a new recording and training within five (5) business days of notification. Provide a digital copy, in MP4 format, on a USB flash drive to the Owner and AV Consultant. Also locate a USB flash drive with the training videos, programing, etc. in the as-built drawer of the main equipment rack. Digital copies sent as a link are not acceptable. identify within the Operating and Maintenance manuals, in the first section, where the flash drive is stored. Clearly label the flash drive as training videos. The second training shall take place within a month of the first training and all questions shall be answered.

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3.8 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 4100

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SECTION 27 4101

AUDIOVISUAL SYSTEM INTEGRATOR VERIFICATION CHECKLIST

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-27 4100 section apply to work specified in this section.

1.2 ADMINISTRATIVE REQUIREMENTS:

A. This Document is intended to be completed and supplied to the AV Consultant prior to the final punch visit. Refer to specification 27 4100 for system components.

B. Installing contractor shall make copies of this document for large systems. Include all copies in the O & Ms and provide all copies to the AV Consultant.

1.3 DESCRIPTION OF WORK:

A. Refer to “INTEGRATOR VERIFICATION CHECKLIST” at the end of this section, for system verification requirements. Fill out the form and return to the AV Consultant prior to the final punch.

B. Upon completion of installation of each system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units on site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.

C. Before inspection by owner and AV Consultant, and after completion of the installation, conduct system tests and make necessary corrections for proper system operation.

D. Adjust, balance and align equipment for optimum quality and to meet the manufacturer’s published specifications.

E. All limiters and/or compressors shall be set to prevent operators from over-adjusting sound levels and damaging system components, while maintaining the highest amount of gain possible.

F. System shall have no audible hum, noise, RFI, or distortion when operating under normal conditions. System shall reproduce material at the loudspeakers rated output level without audible distortion. All input levels shall be pre-set so system may be operated without causing unstable feedback under normal use.

G. System shall have no image distortion, hum bars, color shift, or any other picture distortion while operating under normal conditions. Provide cable equalizers or an HDBaseT video solution. Cable equalizer shall be located near display and powered, on all cables that are more than 30 feet in length or with more than four (4) connection points. Refer to section 2.3.B in this specification for a list of pre-approved equipment. Adjust gain controls for optimum signal-to-noise with 0 dBu at a line-level input.

H. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.

I. Loose parts and poor workmanship or soldering shall be replaced.

J. Sweep Loudspeaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to Loudspeakers or enclosures. Notify owner of external causes of buzzes or rattles.

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K. Equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and 8000 Hz (+/- 3 dB).

L. Contractor shall provide system testing as described herein using up-to-date and industry accepted test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1. AV Contractor shall own and have access to a handheld Quantum Data 780C tester to allow for on-site verification testing and troubleshooting of HDMI and digital video networks and analog video displays. All test equipment used shall be factory calibrated within one year of use with references set daily prior to testing.

M. Contractor shall provide HDCP compliant device with digital cables, and digital HDCP content for testing of routing and HDCP compliant distribution and switching. Also provide analog VGA output equipment for testing of video switching, scaling, and distribution if analog is included with this project.

N. Horizontal cabling contractor shall test all twisted pair cabling used within the AV system following the standards in specification 27 1500 under the testing section. Provide documentation of testing to AV Consultant prior to final walk through.

PART 2 – PRODUCTS

2.1 SECTION NOT USED

PART 3 – EXECUTION

3.1 AUDIOVISUAL SYSTEMS INTEGRATOR VERIFICATION CHECKLIST

Project Title		Date	
City, State		Integrator	
Room/Area			

Audio/Video Signal Processors/Switchers					
Location	Rack #	Manufacturer & Model #	Serial #	Total Channels (In, Out)	Unused Channels (In, Out)

Power Amplifiers						
Location	Rack #	Amp #	Manufacturer & Model #	Serial #	Total Channels	Watts/Channel

Loudspeakers Zones

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Location	Rack #	Amp #	Amp Chan	Manufacturer & Model #	Serial #	Calculated Impedance	Measured Impedance

Wireless Microphone Receivers					
Location	Rack #	Manufacturer & Model #	Serial #	Usable Frequency Range	Chosen Frequency

Portable & Miscellaneous Equipment			
Description	Location	Quantity	Manufacturer & Model #.

Sign below to confirm you have received portable & miscellaneous equipment listed above.

Owner Signature: _____
Date:_____

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Title:_____

Personal Delivering Equipment: _____

General Items

Title	Description	Initial	Notes
Labeling	Verify that all cabling, equipment, and wall plates are labeled per specifications and as noted on drawings		
Cable management	Verify that proper cable management has been provided and that everything looks well-ordered.		
Power	Verify that power supplies are secured and in an accessible area.		
Sequencer	Verify that the sequencer(s) are setup correctly for industry standard power on/off function.		
Cyber Security	Verify that all default passwords have been changed. Provide all login information to the owner representative		
System testing	Verify that all systems have been tested and are in working order.		
System Certification	Verify system has been tested with industry standard testing equipment including the use of Quantum Data 780C		
Cabling	Verify that all cabling on the project meets the document requirements.		
Network	Verify that the owner has all of the needed information for all devices on the network. Provide this information to the owner via a spread sheet.		
Network	Verify that all IP address are within the owner's network scheme.		
Network	Verify that VLANS are setup as indicated in drawings and within owner's network infrastructure		
System One-lines	Verify that each equipment rack contains a set of one-lines diagrams for system installed. Refer to specifications for one-line requirements.		
Thermal Management	Verify active thermal management is setup correctly and working properly.		
Training	Verify training has been scheduled with the owner representative.		

Audio Performance

Title	Description	Initial	Notes
Audio Signal Distribution	Verify that audio signal is being transported and distributed according to project documentation.		

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Phantom Power	Verify that the correct phantom power is provided at the correct locations according to project documentation.		
Gain Before Feedback	Verify that the audio system is capable of reproducing speech above nominal operating levels without audible distortion or feedback.		
Rough Balance (input)	Verify that all inputs have the same nominal level.		
Gain Structure	Verify that proper gain structure has been followed from each input to output		
Rough EQ	In systems with equalization capability, equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and 8000 Hz (+/- 3 dB).		
DSP Programming	Verify that DSP systems have been programmed to allow signal routing, balance, and EQ. DSP programming should be saved in editable form prior to final commissioning visit.		
Rough Balance (output)	Verify that loudspeaker zones reproduce program content at the same level (+/- 1 dB).		
Emergency Muting	Verify that any required muting or operational changes are in accordance with location regulations in the event of a life safety or similar emergency.		
Assistive Listening	Verify that the assistive listening system functions as a complete personal listening system at specified levels without distortion or excessive background noise.		
Loudspeakers	Verify that there is no hum, noise, RFI, or distortion when operating under normal conditions.		
Loudspeakers	Verify that there are no rattles or buzzes with a high-level sign wave or 1/3 octave pink noise.		
Loudspeaker Zoning	Verify that loudspeaker zones are assigned correctly according to project drawings and specifications.		
Loudspeaker Impedance	Verify that all loudspeaker circuits have correct impedance as defined in the project drawings and specifications. Note measured impedance on previous page.		
Loudspeaker Alignment	Verify that loudspeakers are mounted and aligned as shown in project documentation.		

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Loudspeaker Polarity	Verify that all loudspeakers in a given space are wired with the same polarity.		
Loudspeaker Tap Settings	Verify the tap settings on all constant voltage loudspeakers.		
Loudspeaker Delays	Verify that loudspeakers are set with the proper delay. Refer to drawings and specifications for requirements		

Control System Performance

Title	Description	Initial	Notes
Functionality	Verify that the control system functions according to project documents.		
Automatic controls	Verify that the automatic features work ie: room combining, video detection, etc..		
Lighting controls	Verify that the lighting system presents are correctly recalled by the control system as indicated in project documents.		
Shade controls	Verify that the shade controls are correctly recalled by the control system as indicated in project documents.		
Sequencer	Verify the sequencer is controlled as noted in project documents. If no specific requirements are noted, sequencer will be powered on/of from the front panel.		

Video Performance

Title	Description	Initial	Notes
Video Routing & Switching	Verify that all video signals are properly routed, switched, scaled, and displayed according to project documents.		
Projector Alignment	Verify that projectors and screens provide a projected image that is properly aligned and fills the projection area.		
Projector Alignment	Verify that projector and screen are in the correct locations, correctly aligned and keystone correction is not in use.		
Projector Interactivity	Verify that projector touch sensors are calibrated and working per manufacture instructions. Provide offset hardware as needed.		
Image Scaling	Verify that all displayed images are scaled to the full native resolution of displays and projectors in all cases where scaling hardware is specified.		
Image Quality	Verify that all displayed images are correctly focused and are free from distortion.		

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Aspect Ratio	Verify that all displayed images maintain the proper aspect ratio and image geometry. Key-stoning and stretching should not be used. Any exceptions to this should be noted.		
Display Image setting	Displays are set to dot to dot or full. Images shall fill the screen without cropping.		
Signal Bandwidth	Verify that all equipment from endpoint to endpoint supports the resolution/data rate as indicated in the documents.		
System Certification	Verify system has been tested with industry standard testing equipment including the use of Quantum Data 780C		

3.2 OPERATING AND MAINTENANCE MANUALS: Include a copy of this document within the Operation and Maintenance Manuals.

END OF SECTION 27 4101

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SECTION 27 5123

INTERCOMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Refer to specification 26 0553 conduit and junction box color requirements.

D. Refer to specification 27 1500 for category and/or optical fiber cable and connectivity specifications and color requirements.

1. Fiber Optic Cable: Fiber optic cable is the designated media cabling for school backbone inter-building and intra-building wiring. This includes all MDF to IDF or IDF to IDF and vertical riser applications.
2. Copper Cable: Unshielded Twisted Pair (UTP) with the specified category cabling must be used for the horizontal wiring from the MDF, IDF, or CP to the individual communications outlets.
3. Rack and PoE Switches Requirement: low voltage contractor is responsible for equipment racks, and/or communications cabinets unless specifically noted withing the drawings.
    a. The racks must be installed in the MDF and IDFs to support communications systems equipment and the communications distribution system and must match the current School District Standard. Communications distribution cables must be terminated in jackfields and punch-down blocks mounted in the equipment racks or communications cabinets.
4. All intercom cabling shall be installed by division 27 1500 contractor. Coordinate pathways as required.

1.2 ADMINISTRATIVE REQUIREMENTS:

A. Bid Submittal:

1. Equipment Costs: Breakout cost of material and labor as different line items.
2. Provide separate line items for each section that you are being bid on.
    a. Contractor shall not provide a single number with all the sections/scopes combined.
3. System is intended to be a new-build with fully operational Telecor IP platform intercom system. Contractor to coordinate the location of headend and other system component locations, as required, for a complete and working system prior to rough-in.

B. Coordination:

1. Coordinate final inspection of the systems installed, with Audiovisual (AV) Consultant, three (3) weeks in advance.
2. Obtain GANTT chart for construction time frame from the General Contractor.
3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submitting shop drawings to coordinate the

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mounting condition of all ceiling-mounted AV equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted AV equipment in each area.

4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.
5. Meet with Electrical contractor prior to pathway rough-in to coordinate Intercom system requirements in each area.
6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all required drop points are accounted for. Coordinate cable color according to specification 27 1500.
7. Meet at least twice with owner to coordinate network requirements. Hold the first meeting before submitting shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to system deployment.
8. Coordinate color and finish of all system components with Architect or Electrical contractor as appropriate.
9. Coordinate all system components within millwork/furniture with millwork shop drawings prior to rough-in.
10. Intercom contractor shall participate in a mandatory pre-construction meeting no more than sixty (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating meeting. The meeting will be held at AV Consultant's office. All submittals, shop drawings, and bill of materials shall be completed and submitted to AV Consultant for review eight (8) working days prior to this meeting.
    a. Intercom contractor shall attend the electrical pre-construction meeting per specification 26 0500.

1.3 DESCRIPTION OF WORK:

A. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.

B. This section includes a fully operational IP platform Telecor for school internal communications system incorporating school safety notifications and general communications System is intended to provide 2-way communication within specific areas, mass notification, zone announcements, and more as indicated within this document.

1. The platform shall provide complete internal communications employing IP Technology including the minimum functions listed.

    a. Two-way Loud Speaking Internal Intercommunications.

    b. Bell Event announcement

    c. Emergency announcement that will override any pre-programmed zones assuring that all Emergency/Lockdown etc., are heard at each and every loudspeaker location.

    d. Capability of prerecording emergency announcements that can be activated by a Soft Key or via a dedicated call-switch.

    e. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.

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f. Web-based, permission driven user interface.

C. The system specified is based on the Telecor eSeries Supervised Network based Communications System providing at least the features and functions outlined below. The System shall be installed and programmed by a local authorized and certified Telecor dealer.

D. Supply and install a complete supervised network-based intercom system. Field wiring shall be CAT 5E or CAT 6 cable, control wiring for power distributions and very long runs, and utilize an optional fiber backbone (when distances exceed normal Ethernet limitations). All station equipment shall utilize standard RJ-45 modular connections. All remote devices utilizing standard structured cabling shall be capable of PoE (Power over Ethernet) or power supplied within the CAT 5E or CAT 6 cable jacket. Wiring shall be capable of either being installed in conduit or cable trays, where shown on the plans.

E. The system shall be capable of interconnecting with the building LAN (Local Area Network). This connection shall be minimal and utilize only one Ethernet 100 Mbps (or optionally 1 Gb) connection per station to accomplish all intercom operations. Ethernet ports and associated network switches that are required to connect any intercom devices will be provided by the OWNER.

F. Provide a separate circuit for each room and administrative office so each room, speaker, amplifier, and emergency messaging display/clock can be individually addressed.

G. Overall intercom communications network shall utilize Ethernet or VoIP communications between all major components: administrative consoles, intercom stations, amplifiers and individual paging speakers, and network switches. Systems not utilizing Ethernet or VoIP communications protocol to each end-point device will not be acceptable. Systems not capable of supervising all networked devices including network amplifiers, network speakers, notification switches, and emergency messaging display/clocks will not be acceptable.

H. The network shall support a VLAN configuration to separate activity in the intercom system from other in-building LAN traffic. In locations where the supervised network communications system will be considered as part of the facilities life safety systems, a dedicated and isolated network shall be required.

I. The system shall interface to the facility's IP-PBX via SIP trunk connectivity.

J. The Communications System shall include master clock support and synchronization of digital secondary clocks, event scheduling, and messaging software allowing the facility to configure multiple schedules per school, multi zone time tone signaling for class changes, and message notification.

K. The Communication System shall include alarm features, including a comprehensive command center and alarm-focused emergency management capabilities. In the event of an alarm condition, all nonessential system operations shall be automatically suspended. Control of the system shall be transferred to a command center console operated by the incident commander. All call-ins placed from room stations shall be re-routed automatically to the command center console.

L. The Communications System shall include software for the management of communications during an alarm condition in the facility using a GUI located at the command center. This includes activating, clearing and providing status of all alarms in the facility, including comprehensive management of lockdown and acknowledge status of each classroom designated as a Shelter-in-Place location.

M. Equipment submitted in bid proposal that has not been approved by intercom Consultant in writing will not be accepted and shall be replaced by approved equipment at contractor's expense. Equipment not listed within this specification, or contract documents, that are required for a complete and working system, shall be of professional grade and used in the same manner as needed for a complete and working system.

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N. The platform shall provide complete internal communications employing IP Technology including the minimum functions listed.

1. Two-way Loud Speaking Internal Intercommunications.
    a. Paging and two-way loud speaking features shall be accessible from any system console or SIP connected telephone.
2. Bell Event announcement
    a. Bell Schedules shall be easily assigned to days and changed simply with authenticated access to the system through any browser-based device.
    b. Provide a simple calendar-based scheduling system for bells. It shall provide the ability to have an unlimited number of bell schedules.
    c. Provide a calendar-based scheduling up to four years in advance. The system shall be capable of displaying a fully year calendar and differentiating which bell program is scheduled to run on each day in an easy-to-read format. The calendar shall be based on a standard school year and provide a selectable start month.
    d. Provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.
3. Emergency announcement that will override any pre-programmed zones assuring that all Emergency/Lockdown etc., are heard at each and every loudspeaker location.
    a. The system shall automatically broadcast emergency instructions throughout the entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions shall be preprogrammed and require no user intervention. The system shall provide a redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
    b. The system shall have the capability of maintaining a record of all alerts that are received and provide appropriate school personnel the capability to enter information about the alert, which shall be maintained in the systems database. That information shall also be made available to appropriate school personnel in the form of a report that shows all alerts that have occurred, their date, time, and the end alert information.
    c. Capability of prerecording emergency announcements that can be activated by a Soft Key or via a dedicated call-switch.
    d. Shall provide ability to clear status by individual location, region, or global.
    e. Shall provide pop up alarms on Lockdown, Shelter, or Evacuation events.
4. The system shall provide two I/O Ports on each classroom network interface, and common zone network interface which can be used as programmable inputs or outputs to control contact closures. Contact closures can be activated manually to turn on cameras, unlock doors, emergency lockdown, etc.
    a. Connect two (2) ports to the classroom sound amplification system (CSAS) for emergency notifications to and from the classrooms. The CSAS system shall notify the system and the system shall provide feedback to the CSAS indicating the notification went through.
5. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
6. The system shall be a software-controlled system, whose primary interface is a web-based portal, accessible from any authorized computer, and with assignable permission levels for each user.
7. Classroom systems and common zone network interfaces shall be capable of utilizing standard Category based infrastructure, Category 6 or better, for

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installation from the intermediate distribution frames only to the classroom and/or zone, allowing for only one type of wiring infrastructure within the school. Distribution of all voice signaling shall utilize a shared or dedicated IP network.

8. The platform shall provide complete internal communications employing SIP (Session Initiation Protocol) including the minimum functions listed.
    a. Integration with any VoIP telephone system using SIP type integration. It shall allow the school(s) to upgrade or replace their telephone system without requiring the owner to replace, or lose any feature of, their internal communications (intercom) system.
    b. Support a SIP trunk from the building's VOIP phone system to provide hands free two-way communication from all administrative telephones to any location equipped with a talkback speaker or audio system with room microphone
    c. Provide its own SIP environment, and in the case of a failure of the schools VoIP telephone system, be capable of operating completely independently for all functions, except access from the handsets connected to the schools VoIP system.
    d. Access remote classrooms (trailers, temporary classrooms etc.) via IP interface or room audio system with room microphone. Integration with any VoIP telephone system using SIP type integration.
    e. It shall allow the school(s) to upgrade or replace their telephone system without requiring the owner to replace, or lose any feature of, their internal communications (intercom) system.
    f. Any authorized administrator shall be able to call from outside the school into any classroom, zone or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools)
9. The system shall utilize a shared data network (VLAN enabled) or dedicated network as means of distribution for all voice overhead paging, emergency paging, emergency tones, intercom, and class change tones.

O. The system shall support receiving multiple levels of priority, which shall be user definable, that is appropriate for the size of the project. Each end point to place a minimum of a; normal. emergency, ok, and help level priority call depending on the system state at the time of the notification.

P. Authorized system users shall be able to create a minimum of twenty (20) automated sequences with emergency instructions, emails and relay activations and replay them. Automated message strings shall be manually played from a single-button access on the console, on a SIP connected telephone, a panic button or from the web interface.

Q. The platform shall synchronize its system time to the network timeserver or a web-based time server.

R. Installation shall be locally survivable for intercom, paging bells, and emergencies such as lockdown, even when the district connection is unavailable.

S. Input plates shall match the color and style being used throughout the project.

T. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.

U. Interconnect the Fire Alarm system to the intercommunications system such that upon activation of any initiating device, a preset audible alarm will be sent to all intercom speakers. In addition, the contractor shall provide all controls necessary between the two systems such that upon silencing the alarm on the fire alarm panel, it automatically silences the audio file in the intercom system.

V. Interconnect the Access Control system to the intercommunications system such that

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upon activation of an Emergency Lockdown or Preventative Lockdown from the administrative console, web browser, app, etc., a communication protocol will be sent from the intercom system to the access control system that will allow for all controlled doors to be locked, a designated campus wide communication throughout the building, emails, SMS text, etc. A minimum of two types of initiations process shall be programmed e.g. “Emergency Lockdown or “Preventative Lockdown” In addition, the contractor shall provide all controls necessary between the two systems such that the system can easily be reprogrammed to meet the needs of the School District.

W. AV contractor shall participate in a mandatory pre-construction meeting no more than (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating meeting. The meeting will be held at AV Consultant’s office. All submittals, shop drawings, and bill of materials shall be completed and submitted to AV Consultant for review (8) working days prior to this meeting.

1. AV contractor shall attend the electrical pre-construction meeting per specification 26 0500.

1.4 QUALITY ASSURANCE:

A. Manufactures: Firms regularly engaged in manufacture of integrated communication systems, time keeping systems, and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for no less than five years.

B. INSTALLER:

1. Firms with at least five years of successful installation experience with projects utilizing integrated communications systems and equipment similar to that required for this project.
2. Integrating firm shall have worked satisfactorily for a minimum of (5) years of completing systems equal to this scope, quality, type and complexity.
3. Key personnel assigned to the project shall each have minimum of (10) years of experience in completing systems equal to this scope, quality, type and complexity.
4. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
5. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
6. Contractor shall have current manufacturer certificates for system and equipment listed within this specification.
7. All contractors biding on this project must have local representation that is within 4 hours of the job site.
8. Any contractor that cannot meet this requirement shall not bid on this project.

C. All items of equipment including wire and cable shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

D. The Contractor shall be an established communications and electronics Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.

E. The Contractor shall show satisfactory evidence, upon request, that they maintain a fully equipped service organization capable of furnishing adequate inspection and service to the system. The Contractor shall maintain at their facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

F. Except where specifically noted otherwise, all equipment supplied shall be the standard

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product of a single manufacturer of known reputation and experience in the industry. The Contractor shall have attended the manufacturer's installation and service school and upon request must show proof of attending such a school.

G. Contractor must follow the standards described within:

1. BICSI/AVIXA AV Design Reference manual.
2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

I. Comply with NFPA 70 and with NEMA Standard SB-40 for Emergency Communications in K-12 schools.

J. Comply with UL 60950.

1.5 SUBMITTALS: Refer to Section 26 0502 for requirements.

A. The following items shall be included in the shop drawings submittal.

B. Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.

C. Shop Drawings: Composite wiring and/or schematic diagrams of the complete system as proposed to be installed. Drawing shall include relative position of all major components, typical connections, field components, accessories, and cable types.

D. Product Data: Include catalogue data sheets, manufacturer's default specifications, user operation guides, and bill of materials.

E. Quality control shall include the following:

1. Name, address, and telephone number of the nearest fully equipped service organization.
2. Submit a certificate of completion of installation and service training from the system manufacturer.
3. Submit a list of comparable completed projects. Furnish the name, address, telephone number, and contact name of end user.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

G. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.

1. Record of Owners equipment-programming option decisions.
2. All instructions necessary for proper operation and manufacturer's instructions.
3. "Proof of Performance" information.
4. Manufacturer's maintenance information.
5. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.

H. Record Drawings: Prior to final acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".

I. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.

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1. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
2. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
3. Include with the submittal a current copy of trainer's needs assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
4. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.

J. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary.

1.6 WARRANTY:

A. Provide a manufacturer's five-year extended limited warranty of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic system components. Additional warranties cover clocks, speakers, and call-in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one-year warranty shall be provided for labor.

B. The Contractor shall, at the Owner's request, make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

C. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

D. Systems shall be guaranteed for a period of one (1) year from the date of substantial completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor.

E. If system failure causes audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair system so it will be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.

F. Contractor shall supply a one (1) year warranty on all system programming from the date of substantial completion. During this time period, upon owner request, the contractor shall provide programming changes up to four (4) times free of charge. During this time the programs shall be password protected. At any time during the (1) year, the owner can terminate the warranty and request the programming of each system. At this time the programs are to be turned over to the owner and all passwords are to be removed. The owner shall own all rights to the programming after this time, to be used in this facility.

G. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

H. Prior to the end of the 1-year warranty. The Intercom Integrator shall preform the following:

1. Three (3) months prior to end of warranty remind the owner and design consultant that the end of the warranty is approaching. At this time coordinate the events below with the owner and notify the design consultant of the time of the walk through(s).
2. One (1) month prior to end of warranty, walk through campus and verify all components are working. Supply list of components with location, type

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equipment and status to the design consultant and Owner. Correct any and all malfunctions as necessary.

PART 2 - PRODUCTS

2.1 GENERAL:

A. The platform shall utilize state of the art IP Technology, Call-in Notification, School Safety Paging and Evacuation tones, IP infrastructure, Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Intercommunications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web based and user friendly to allow the system administrator the ability to easily program system features.

B. Provide complete and satisfactorily operating school communications and school safety as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

C. Intercom paging system power and network intercom interface:

1. Shall allow users to install intercom paging systems spanning multiple building or facilities connected through a VLAN. Provide a 100/1000 Ethernet switch port configured on a dedicated VLAN.
2. All Network interfaces used in the classroom and for the common zones shall be powered via PoE+ from the network switches.
    a. PoE+ switches and network cabling from MDF (Main Distribution Frame) and IDF (Intermediate Distribution Frame) to devices.

D. All network switches shall include an uninterruptable power source to provide adequate runtime. In the event the school has a generator the UPS systems shall hold the switches long enough until generator power can be provided.

E. The platform shall be a single electronic system consisting of intercom channels, (classroom) IP loudspeakers, corridor loudspeakers, inside and outside horns, call-in switches, and SIP phone integration.

F. Call-ins shall:

1. Be automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones and outside phones.
2. Be programmed to automatically change priority and annunciation route based on age of call-in and original priority.
3. Have priority and annunciation routing changed by user action from a console or SIP enabled phone.
4. Be annunciation routing shall include playing pre-recorded audio over speakers, sending a pre-configured e-mail and/or activating relays.

G. The platform shall lend itself to expansion by simple addition of hardware modules.

H. The platform shall directly connect to the WAN/LAN without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

I. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.

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J. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands free and will not require any interaction by the classroom user.

K. IP addressable loudspeaker modules for individual rooms shall be system programmable and may be assigned any two, three, four, five or six digit number as well as name and description. Any extension may be reassigned at any time.

L. IP-enabled two way voice communication shall be available from any provided telephone or administrative console through any IP loudspeaker in the system. This shall allow hands free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when loudspeaker monitoring is active, complying fully with all privacy legislation. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.

M. Integrated Master Clock with unlimited schedules, unlimited events, and automatic Daylight Savings time correct. Up to 5 schedules may be active on any given day for each school. User shall be able to select from 25 standard included tones or unlimited user created and uploaded audio files for class change signaling and messaging. In addition scheduled events shall include relay actions and email notifications. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate computer at the school location. Bell schedules can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

2.2 Telecor SYSTEM REQUIREMENTS

A. The system shall utilize a decentralized network structure not requiring any head-end equipment, central server, or any other control hardware to maintain system operation. Systems utilizing centralized electronics and subject to a single-point-of-failure (power supply, CPU, server, power, etc.) shall not be accepted unless the system has 100% duplication of all centralized operating equipment running concurrently and can automatically take over, including up to the minute programming configuration in the event of a failure of the main system head-end electronics or any required, centralized electronics required to make the system fully operational. Systems that are not based on decentralized structure or systems that do not provide 100% duplication of head-end or systems that operate in a “down-graded” operational mode as the result of a centralized failure are not acceptable.

B. All station devices shall receive power and data through a Power-Over-Ethernet switch. Once plugged into the LAN through a Power-over-Ethernet network switch, all networked devices shall be immediately operational and as applicable shall place or receive calls and pages from stations as well as page all devices in the network. Consoles, intercom stations, clocks, emergency displays, or speakers connected to the network shall not require any network configuration or administration to function.

C. Each Intercom Station, Loudspeaker, clock/message display, shall be assignable to all or any combination of Unlimited Paging, Program Distribution or Time Zones in the system.

D. Each Classroom shall be provided with two Call Stations located in separate locations in order to comply with NEMA Standard SB40 for Emergency Communications in K-12 Schools. One Call switch shall provide the ability to generate normal calls to a designated location while the other shall generate Emergency level calls.

E. Speech shall be transmitted in the frequency range from 50 Hz to 7 kHz and shall use a maximum of 128 kbps of bandwidth during a call. In order to assure maximum intelligibility, all system audio shall be HD Audio as defined in Intel™ High Definition Audio Specifications, June 17, 2010.

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F. Intercom communications between consoles and system devices shall be non-blocking with no channel restrictions or limitations (other than network capacity) to the number of simultaneous conversations at any time between pairs of intercom stations, intercom station to console, console to console, console to speaker or zone of speakers, program source to a speaker or zone of speakers, or bell tones to a speaker or zone of speakers regardless of number of stations or consoles.

G. Any and all devices shall have the ability to have their programming downloaded, individually or simultaneously via the network. Programming shall be downloadable in a series of human readable, industry standard comma-separated values (CSV) files that can be saved and edited using common spreadsheet applications. Consoles, intercom stations, clocks, displays, and speakers residing on a network shall have the ability to update their programming, simultaneously from a CSV file. Furthermore, all devices shall also have the capability to be configured directly, such that device numbers, names, zones, and call-in destinations can be altered in real time without the uploading or downloading of their programming. System shall be capable of uploading firmware updates to all device classes simultaneously, via the network, without the requirement of tools, by authorized technician or qualified facility technician or representatives.

H. Audio communications between all devices shall be accomplished with latency values of a maximum of 0.1 seconds and connection times of 0.01s for 1 to 500 speakers.

I. The system shall support a minimum of 50 channels of simultaneous duplex communication paths on the intercom system LAN, plus a minimum of 10 simultaneous duplex channels for PBX integration.

J. The system shall support Common Alerting Protocol (CAP) Messaging. Any CAP messages received shall be broadcast to the devices on the communications system. Messages shall be configured to be broadcast to all zones or to specific zones of devices in the facility.

K. Text-to-Speech, shall be provided allowing a user from a PC to key text which shall be converted to Audio and broadcast to speakers on the communications system.

L. The system shall provide Automatic Feedback Management. Room station devices shall be configured to automatically reduce the volume of paging announcements in order to prevent feedback when a paging announcement originates from a console in the vicinity of a speaker. when made from specific devices.

M. Using their PC microphone staff shall be able to record audio and broadcast it to speakers on the communications system.

N. The system shall be capable of routing calls from the Public Switched Telephone Network (PSTN) into any classroom, zone or the entire school via the District's SIP enabled Telephone System. This shall allow for remote monitoring and two-way voice communications from outside the facility to classrooms as well as paging into areas of the school. Additional features shall include:

1. The ability to place call-ins from classroom call stations to SIP Telephones.
2. The ability to initiate calls from SIP Telephones to eSeries Classroom Speakers.
3. The ability to initiate zone and all call paging announcements from SIP Telephones to eSeries Speakers throughout the facility.
4. The ability to make outside calls from Administrative Consoles to the PSTN via the Districts Phone System.
5. The ability to receive Live District Wide Paging Announcements from the District Office

O. The System shall allow users to configure multiple schedules per school, with an unlimited number of programmable events in each schedule. Each Event shall sound a user selectable tone, play a user provided audio file or an external audio source. In

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addition, a textual message shall be programmed to display on associated message displays throughout the school. All scheduling assignments shall be performed via a simple to use, Graphical User Interface (GUI) from a non-dedicated PC, residing in the School. Programming shall also be accomplished from a non-dedicated PC at the District Office. The following features and functions shall be provided. Systems that cannot provide these, shall not be acceptable.

1. The system schedules shall facilitate the requirements of combined facilities (e.g. elementary and middle schools in a common building) where multiple schedules running concurrently would be required.
2. Each event shall play any of the available tones, audio files or audio sources provided. Events shall be directed to any one or more Time Zones in the systems.
3. Events shall include textual messages to clock/message displays. These shall be formatted as fixed, flashing or scrolling displays that can include up to 200 characters in length.
4. Time Tones may be manually activated from Administrative Consoles or selected SIP phones residing on the schools IP PBX.
5. An integral Master Clock shall provide time synchronization to all secondary, digital clock/Message Displays throughout the school. The communications shall be capable of obtaining it's time synch signal from any NTP timeserver.

P. The System shall be capable of automatically distribute SMS and email notifications to relevant staff members when an emergency event is occurring the facility. Notifications shall be distributed to user alert devices such as mobile phones and smart devices. Mobile phones shall receive the notifications as SMS messages while smart devices shall receive email messages. Emergency events include:

1. The activation of emergency-themed element icons on a PC GUI (e.g., Lockdown, Evacuate, etc.)
2. Emergency Calls placed from Call Stations located room locations.

Q. The system shall automatically distribute SMS and email notifications to appropriate technical support staff in the event that the system is experiencing a fault.

2.3 EQUIPMENT AND MATERIAL

A. Supervised Interactive Graphical User Interface

1. The system shall include an Interactive Graphical User Interface (subsequently referred to as IGUI). The software shall reside on Telecor provided PC and should have ability to interface to District Wide Emergency Communication system located in the district office.
2. The IGUI shall be supervised and shall utilize an easy-to-use graphical user interface for quick and easy graphically aided navigation to access functionality for all intercom stations, paging zones, and program distribution sources. Emergency operations shall be simplified through the IGUI allowing stored audio files and alphanumeric messages for message displays to be activated from the IGUI. The IGUI shall allow common operations such as daily announcements to become simplified into single touch activated icons; removing multi-step console set ups and dial strings.
3. The voice device used to originate voice communication for the IGUI to selected locations shall be a system console, telephone handset, or microphone independent from the computer hosting the IGUI. The voice device shall remain functional and accessible regardless of the operational state of a computer supporting the IGUI.

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4. The IGUI shall allow the creation of a custom operating screen(s) based on the floor plans of the facilities. Icons representing intercom stations, zones used for paging, tone distribution, textual Message distribution, and audio program distribution shall be incorporated onto the floor plans. The IGUI software shall provide:
    a. Simple routine call processing, including: hold, transfer, and forward
    b. Activation of remote station auxiliary relays for applications such as door lock or release
    c. Emergency functions
    d. Paging
    e. Audio program distribution
    f. Customizable page elements
    g. Customizable operating screen
    h. Element library for emergency event icons
    i. Initiation of emergency and non-emergency messaging, textual and audible
    j. Remote station volume adjustment
    k. Remote activation of do not disturb status and/or message waiting status
    l. Remote station trouble indication
    m. Remote station background music channel selection
    n. Dynamic zone management for interactive on-the-fly console specific zones
    o. Single touch emergency response (supporting both actual emergencies and drills) including but not limited to all or any combination of the following:
        i. Live voice notification
        ii. Pre-recorded audio message
        iii. Digital plain text messaging with simultaneous numerically coded message capability
        iv. Remote system activation, i.e., access control systems, CCTV systems, door release systems, etc.
5. The IGUI must provide an efficient and reliable method of notifying the occupants within the facility of critical situations. A variety of emergency tone signals that reside within the intercom/paging system shall be activated by clicking on pre-programmed buttons on the IGUI screen, initiating the transmission of tone signals to speakers, and alphanumeric messages to message displays/digital clocks. A “lockdown” icon shall be designed as per Owner direction, with Owner selecting the appropriate tone. Whole building macros for emergency or off-normal response shall be built into the internal communication system as directed by the Owner. Each macro shall be capable of being activated by the console, the IGUI as indicated on plans or as directed by the Owner or AHJ. It shall be possible to activate a WAV file message or Owner selected tone coinciding with multi-language textual messages for distributions to zones as directed by the Owner, all from a single activation icon located on the IGUI. Other single action macros shall be activated in similar fashion via the IGUI and a custom-labeled icon. Plain language labeling of all icons on the IGUI shall be user changeable.

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B. Emergency Notification

1. The system shall be capable of providing emergency notifications by email and SMS to mobile devices and designated PCs. during an emergency utilizing a district wide communication system. This feature will notify all relevant staff members so that they are made aware of the emergency event and can respond appropriately. Up to 100 users can be supported directly. When integrated with the facility's email server, it can effectively distribute notifications to an unlimited number of alert devices.

2. Alert devices may be mobile phones and smart devices. Mobile phones shall receive the notifications as SMS messages while smart devices shall receive email messages.

3. When deployed, the emergency notification feature shall support the fault monitoring capabilities of the Master Clock/Message Host. Trouble/fault notifications from eSeries devices shall be annunciated on the IGUI with a flashing Icon. Activation of this icon shall distribute notifications of a fault to appropriate technical support staff.

C. Emergency Alert

1. The Emergency Alert platform shall consist of displays, adapters, and integrators as located on the drawings and specifications.

2. The platform shall allow visual displays to be integrated into Telecor's eSeries System. These displays shall show the time, weather, information, alarms, messages, and emergency alarms. Multiple visual layouts and color schemes shall be available for use. The time shall be displayed as either an analog or digital clock. Messages and emergency alarms shall include plain text and audio. Messages shall have the ability to be scheduled to appear at certain times and days of the week. Live local weather at the facility shall also be shown on each screen.

3. Messages shall be configurable to appear on specific displays and zones (which shall group together multiple displays).

4. Severe weather notifications issued by the National Oceanic and Atmospheric Administration (NOAA) shall activate weather alerts automatically.

5. Emergency alarm screens shall be activated from the IGUI. This shall allow complete integration with an operational control from the facility's Telecor communications system. Emergency Alert alarms shall activate in conjunction with the delivery of SMS text messages and email notifications.

6. The Emergency Alert platform shall support an unlimited number of displays. All displays shall have adjustable brightness levels. A scheduled sleep mode feature shall be available for further energy conservation. Should a display lose power, it shall automatically resume regular operation upon power and network restoration.

7. Displays shall connect via wired Ethernet or wireless Wi-Fi to the facility LAN which shall have access to the Emergency Alert cloud-based web portal. This portal shall be used to manage and configure the Emergency Alert platform and its features. The cloud-based nature of the Emergency Alert platform shall provide the ability to manage different sites, each with their own sets of displays, through the web portal.

8. The Emergency Alert display shall consist of a 22" HD screen. The display shall be equipped with both wired and wireless network adapters for connection to the facility LAN.

9. The display shall be wall mounted with a surface mount bracket in either a

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landscape or portrait orientation.

10. The adapter shall allow any third-party display capable of receiving HDMI input to serve as an Emergency Alert display. This shall include large-format HD resolution displays. The adapter shall include wired and wireless network adapters to allow the display to connect to the facility LAN.

11. The integrator provide integration between Telecor's eSeries System and the Emergency Alert platform.

12. Emergency Alert platform messages and emergency alarms shall have the ability to be configured so that they can be activated from the IGUI.

D. Supervised SIP Trunk IP/PBX Interface

1. The system Session Internet Protocol (SIP) Interface shall be a VoIP PBX phone interface of the same manufacturer as the supervised network intercom and paging system. Third party gateway devices shall not be accepted.

2. The SIP Interface shall be supervised and shall connected directly to the facilities network and the PBX's network and shall provide the following:

a. Establish a barrier gateway between the intercom and paging network and the PBX and/or common computer network.

b. Transparent audio operation between VoIP PBX phones and any device on the supervised network intercom and paging system. Paging access from any telephone on the facility system VoIP PBX to any intercom speaker, speaker zone, intercom station, console, all speakers, or paging horns and zones throughout the facility.

c. Any call-in from the supervised network intercom and paging system shall be capable of being routed directly to a VoIP PBX phone. Call-in stations can be configured and programmed to automatically dial any number on the publicly switched telephone network, landline, or cellular number through the SIP interface and via the PBX.

d. Ability to escalate a call-in to be redirected to a VoIP PBX connected phone via the SIP Interface. Escalation can also include the ability to dial any number on the publicly switched telephone network, landline, or cellular number through the SIP interface via the PBX.

e. Ability to initiate alarm and crisis response protocols from any VoIP PBX connected phone.

f. Ability to require security access code to utilize the intercom or paging system emergency communication features.

g. Minimum of 10 simultaneous telephone channels of access to/from VoIP PBX phone system. Full caller ID support from any supervised network intercom call-in device to a VoIP PBX connected phone identifying the calling station ID/Location.

h. Emergency level call-in to be uniquely identified as emergency on the VoIP PBX phones.

i. Activation of all supervised networked intercom and paging system emergency tones and pre-recorded announcements from any phone connected to the building VoIP PBX phone system.

j. The SIP Interface shall additionally allow for calls to be placed from a console to any phone number on the publicly switched telephone network (landline or cellular). Additionally, intercom calls at a console may be transferred to any number on the publicly switched telephone network to any landline or cellular number through the SIP interface via

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the PBX.

3. Systems that connect to a building or district phone system and are limited to a SLT or CO connection will not be accepted as a substitute for a fully operational SIP Interface.

E. Control Interface

1. The Control Interface shall provide a Desktop Application for PC interaction with the Intercom and Paging system, a Command Interface Protocol for external system interaction with third party systems, Group Zone functionality, and a Scripting Engine supporting multiple sequential operations.

2. The system shall incorporate a Windows based Desktop application that makes use of a Command Protocol Interface, allowing external systems to interact with the Network Intercom and Paging System. Combined with the Scripting and Group Zones features, the Desktop application shall generate a preprogrammed series of operations from a single action. These features shall be used in conjunction with a graphical user interface and the Microsoft Windows desktop.

3. Default Scripts shall be used to generate customized shortcuts according to the needs of a facility. These shortcuts shall then be placed directly on the Windows desktop and shall activate virtually any Intercom and Paging function by clicking on the shortcut icon. These shall include activating:

   a. Alerts, audio distributions, coded and plain text messages, intercom operations.

   b. Pre-Recorded Evacuate, Lockdown, and All Clear audio files.

   c. Companion text messages for audio alerts.

   d. Coded messages on all secondary digital clocks and displays.

4. The Desktop Application shall also activate SMS text messages, computer pop-up notifications, and email distributions in conjunction with any script. Desktop icons such as a Panic Button shall send SMS notifications to a crisis team, advance warning to building occupants through pop-ups to heighten the level of awareness.

5. Any Desktop location running the Application shall have the ability to create and send an instant message using the Desktop's keyboard and display. The textual message can be sent independently or as a companion message to an audible alert.

6. The Desktop Application shall be capable of utilizing Soft Call and Panic buttons. Soft Call buttons shall be created to operate as a call button on the desktop with a normal or emergency call priority. They shall also be combined with other preset or on-the-fly custom text messages. Panic buttons shall allow a user to unobtrusively activate an audio path from the panic button location to another eSeries device at a security location. This shall allow security personnel to listen to an occurring situation and provide the appropriate response.

7. The System shall be capable of streaming multiple audio programs over 10 available channels, simultaneously, to speaker locations in the facility. The ability to turn the broadcast on or off to a specific location shall be controlled from the Desktop Application.

8. A user from the Desktop Application shall enable or disable Do Not Disturb (DND) mode for a group of devices such as speakers or intercom stations.

9. Volume Adjustments to individual devices, devices in a zone, or all devices in the intercom and Paging System shall be made from the Desktop Application.

10. The Desktop Application shall be used to create a call directory to provide the

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user with the ability to quickly and easily place calls to a large number of prospective recipients and locations. The shortcuts shall be customized with the name of the call recipient or location. The call directory shall also contain shortcuts that activate message-waiting indications in addition to the option of placing calls.

11. The system shall interface with other external systems using a Command Interface Protocol. External systems include integrated security management or building management systems via devices such as computers, programmable logic controllers, or software-based annunciator panels.

12. The Command Interface Protocol shall be used to send real time commands and receive real time status messages between the third party system and eSeries devices. The Command Interface Protocol shall be an ASCII protocol that includes both outbound messaging, and support for inbound command via a virtual COM port and a physical USB connection.

13. Scripting shall allow operations to be carried out in sequence. Scripts shall be activated in various ways including: automatically based on the day of week and time of day, using a Console or a phone, by using the Desktop Application, or from other scripts.

14. When scripts from a Console or PBX phone (via a SIP interface), the name of the script shall be displayed on the Console or phone. Then the user shall be presented with options to enable or disable the script (depending on the current state of the script). Consoles and PBX phones that dial the script number shall hear voice prompts for enabling or disabling the script.

15. Scripts shall be used for scheduling time tone programs that include tones, pre-recorded messages, and textual messages displayed on Message Display/Calendar Clocks reoccurring at specific times and days.

16. Scripts shall perform cascading evacuation operations where evacuation audio messages are automatically first distributed to zones closest to the location of an emergency before spreading outwards to other zones according to a time schedule, thus reducing evacuation route congestion throughout the facility.

17. Group Zones shall allow groups of page zones or devices to be defined as a group zone with a dial number. Group Zones shall be accessed from the Desktop Application, Consoles or PBX phones.

18. Group zones shall be the destination for various functions including textual messages, or audio operations, such as pages or audio program distributions). Group zones shall be assigned customized names, which will appear on Console or phone displays when they are dialed.

19. Group Zones shall make it possible for a dial number to be forwarded to different destinations based on time and day. For example, common audio operations directed to a Group Zone dial number shall be configured to go to the usual destination during regular hours but to a different destination outside of regular hours.

20. Group Zone shall support designated priorities, such as emergency. Operations that are to a zone with a priority are automatically elevated to override any normal or lower priority operations the devices in that group zone are receiving.

F. Alarm Manager

1. The Alarm Manager shall be a Telecor Model eAM equipped with eVCAM software or approved equal. The Alarm Manager shall manage system wide communications during an alarm condition in the facility through a GUI and associated software. The Alarm Manager and associated software shall reside on the facility-provided PC.

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2. During an alarm condition, all non-emergency operations shall be restricted. Operations shall be transferred to an Alarm Management Console located at the Command Center location within the facility. The command Center shall be equipped with a Console, associated GUI, PC and software to manage emergency operations during an alarm condition.
3. Included in the GUI shall be ICONS that represent the following alarm types:
    a. Lockdown
    b. Lockout
    c. Evacuation
    d. Reverse Evacuation
    e. Severe Weather
    f. Tornado
    g. Fire
    h. CO Detection
    i. General Emergency
    j. All Clear
4. Alarms shall be activated by “Clicking” on the respective ICON on the GUI. When the corresponding alarm becomes active, the ICONS shall visually change to reflect the current condition.
5. Operation of the Alarm Management Console shall be consistent with NFPA72 Emergency Communication Requirements. Operations activated by an Alarm Management Console shall have the highest priority and shall not be overridden by another operator. This shall eliminate the risk of different operators issuing conflicting instructions.
6. The Alarm Management Console shall perform live paging announcements which shall automatically suspend a pre-recorded portion of an alarm until the conclusion of the paging announcement.
7. From the Command Center, it shall be possible to change the type of alarm, silence an alarm, perform live paging in the alarmed areas, covertly listen to stations, as well as clear the alarm.
8. Call-ins placed from stations in an alarmed area shall automatically be routed to the Alarm Management Console during an alarm condition.
9. Locations designated for “Shelter in Place” such as classrooms, offices, and areas of refuge shall be equipped with Alarm Acknowledgment call stations. These stations shall be used to confirm the status of the occupants in these locations during a Lockdown Alarm Condition. Call stations shall receive pre-recorded verbal instructions to be carried out to secure the “Shelter in Place” locations. Once secure, the status shall be acknowledged by pressing a touch point on the Alarm Acknowledgement Call Station.
10. All “Shelter in Place” locations shall be monitored on the Command Center GUI in real time using the Alarm Manager software. A graphic of the school floor plan shall display the status of the room with color-coded ICONS.
    a. Orange shall indicate that the room has received instructions to secure the room and acknowledgement is pending.
    b. Green shall indicate that the room has acknowledged that the room is secure.

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c. Red shall indicate that the room status is unknown as no acknowledgement has been received from the room.

11. If the Alarm Acknowledgement is not received from the room location after a preset period of time, the station shall automatically place a call to the Alarm Management Console. The Console Operator shall answer the incoming calls utilizing the covert listen function, which allows the operator to aurally monitor the room without the occupant's knowledge. During a convert listen operation, the pre-announce and supervisor tones are suspended. Once the operator determines that the conditions in the room are typical of the situation, the operator shall establish a two-way intercom conversation with the classroom to determine why people in a Shelter-in-Place location did not complete the emergency response procedure.

12. The Alarm Manager shall support Medical and Security Alert Calls from Alert Call stations. Calls from these stations shall be annunciated at the Alarm Management Console, identifying the origin and type of Call. In addition, a pre-recorded announcement stating the origin and type of alarm shall be broadcast over the local speaker, and a textual message shall be scrolled on the local Message display. The audio broadcast and the textual message shall also be broadcast to one of more zones of loudspeakers.

G. Master Clock/Message Host

1. The Master Clock/Message Host shall be a time master device for the eSeries network which enables configuration and activation of eSeries operations from a web-based graphical user interface (GUI). An unlimited number of operations shall be managed for activation by schedules or users. The application shall be web-based and secured via HTTPS certification. It shall be preconfigured with a variety of default operations, schedules, audio, and icons for quick customization. Users shall log into the application from any desktop computer or mobile smart device using a supported web-browser. Supported web browsers shall include Microsoft Edge, Mozilla Firefox, Google Chrome, and Apple Safari.

2. Master Clock/Message Host functionality shall include central time keeping and synchronization of all other eSeries devices throughout the eSeries network.

3. The Master Clock/Message Host shall manage an unlimited number of calendar-based schedules, which are collections of operations intended to be performed frequently, periodically, or on specific dates and times. For example, a schedule may be a series of bell tones that consistently indicate class changes. Users shall set schedules so that the operations they contain will activate accordingly.

4. Schedules shall be viewed, enabled or disabled in a calendar. The calendar shall display schedules on a daily, weekly, monthly or yearly basis. The Master Clock shall support scheduling operations up to 10 years into the future.

5. An unlimited number of holidays shall be specified and marked on the calendar. This shall indicate days where disabling all schedules may be appropriate.

6. The Master Clock/Message Host shall obtain time from and synchronizes with Network Time Protocol (NTP) servers directly or via an NTP-enabled SIP interface present on the eSeries network.

7. Operations shall include several components, including: pre-announce tones, pre-recorded audio, scrolling textual messages, and coded messages. If desired, specific details of the components shall be customized. Customization shall include: the number of times the pre-announce tone plays, the message scroll speed, and the delay before pre-recorded audio repeats. Depending on the operation type, user-activated operations shall be distributed immediately or queued for later distribution.

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8. The Home page shall provide a quick overview of Master Clock/Message Host managed operations. This shall include the next scheduled operation, the schedules that are currently active, and the next scheduled school drill. The Master Clock/Message Host shall include user specific short tutorial videos that explain various aspects of the GUI and provides built-in on demand training.

9. The Live page shall show currently active and upcoming operations. A history of recently performed operations shall confirm operations occurred as intended. Also, users shall easily initiate on-the-fly operations on the Live page by configuring and activating them on demand.

10. Routine operations shall include an unlimited number of pre-configured common audio distributions. Examples shall include announcements for special assemblies, bus arrivals, staff meetings, and festive events.

11. Operations shall be associated with eSeries scripts so that they shall be activated by users. The Master Clock/Message Host GUI shall indicate if the script is active even if it was activated via other means such as dial access code or IGUI. Other emergency operations (such as Lockdown) shall also be seamlessly integrated with the IGUI.

12. Audio files shall be used for tones or announcements while images shall be used as icons throughout the GUI to represent different operations or schedules. Audio file formats shall include (WAV and MP3) and images to support operations.

13. Access shall be user-account controlled. An unlimited number of users shall be supported with a high level of individual customization. Users shall be given access to only the pages and operations relevant to their intended roles. For each page, users shall be granted permissions to activate or configure operations and schedules from a desktop or, for certain users, from mobile devices. An administrator account shall have full access to view and make configuration changes on all pages, while an operator account shall be limited to activating routine or emergency operations and enabling or disabling schedules.

14. Users with administrative privileges shall have the ability to configure the site name, time, time zone, test zone, and import and export databases. To aid installers with initial configuration, a test mode shall be provided as well as a database import/export feature. Test mode shall redirect all activated operations to a test zone (that only the installer occupies) to prevent disrupting other people during configuration and testing. Database import/export shall allow the configuration to be exported for backup purposes or to copy to other installations.

15. The system shall be configured for an unlimited number of dedicated emergency response operations. A corresponding drill operation shall be automatically created for each emergency situation. Users shall activate emergency response operations from facility PCs or remote mobile devices.

16. The Master Clock/Message Host shall support the operation of Virtual Call Stations that reside on client PCs, including management of all network connections between Virtual Call Stations and the Network Intercom and Paging System.

17. The Master Clock/Message Host shall feature a Maintenance Portal. The portal shall provide trouble notifications for faults being experienced by any eSeries device on the eSeries Network.

    a. The notification includes a details fault report that provides the device name, dial number and the nature of the fault. These shall be easily copied into other documents and emails.

    b. The Portal shall be configured to use an email account to automatically send trouble notification emails to a list of designated addresses. These

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emails shall list the details of all the current faults.

c. A link to the Master Clock/Message Host web interface shall be provided in order for the recipient to perform trouble shooting actions such as viewing up to-do-date fault information, enabling service mode status, and making configuration changes.

d. The volume of station devices shall be remotely adjustable via a web browser.

H. Supervised Speaker Breakout Module

1. The Speaker Breakout Module shall provide the means of integrating traditional analog speakers and call initiating devices to the eSeries System. The Speaker Breakout Module shall also be a Single Zone Paging Adapter that can drive an amplifier to provide paging coverage in a facility. The Speaker Breakout Module shall have three relay outputs that can activate automatically during a call processing operation.

2. The Speaker Breakout Module shall receive power and data through a Power-Over-Ethernet switch. Once plugged into the LAN through a Power over Ethernet network switch, the Speaker Breakout Module shall place or receive calls and pages from the eSeries network. The Speaker Breakout Module shall not require any network configuration or administration to function.

3. Speech shall be transmitted through the Speaker Breakout Module in crystal-clear HD Audio. Audio shall be transmitted in the frequency range from 50 Hz to 7 kHz and shall use a maximum of 128 kbps of bandwidth during a call. Audio between the Speaker Breakout Module and Consoles shall be non-blocking.

4. The Speaker Breakout Module shall support Ceiling Inlay Speakers which shall connect to the Speaker Breakout Module via a standard CAT5 cable or conventional 8Ω/25V/70V speakers to provide paging and talkback operation from Consoles or phones via a SIP interface and an IP-PBX.

5. The volume of the speakers shall be adjustable individually, by zone, or across the entire eSeries network via the Management Interface or Control Interface. Volume controls incorporated into certain call station models shall also allow a user to adjust the speaker volume locally. Volume levels shall be set by specific functions: intercom, paging, emergency paging, and Public Channel operations.

6. Call-in capabilities shall be provided with the addition of call stations. Call stations models shall be able to initiate normal calls, emergency calls, or both. Advanced stations that provide additional features shall also be available. These features shall include Privacy mode, Do Not Disturb mode, volume control, and Public Channel select. All call stations shall also provide "message waiting" indication.

7. The Speaker Breakout Module shall also support placing normal and emergency priority call-ins. Emergency Call Stations shall be separate and clearly labeled with a red button so as to impart obvious operation in the event of an emergency. Systems that only provide a single call station with dual emergency and normal operation based on a sequence of button presses shall not be acceptable.

8. The Speaker Breakout Module shall support Receivers which shall detect signals from Wireless Panic Buttons. When a signal is detected, the receiver shall initiate an emergency level call-in to the Administrative Console identifying the location of the call. The console operator shall immediately establish two way communications with the location that initiated the call.

9. The Speaker Breakout Module shall have the ability to direct normal and emergency call-ins to different devices. If the device that is configured to receive the call-in loses network connectivity, the Speaker Breakout Module shall

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automatically search for an alternate destination. If no other suitable call-in destinations exist, the Speaker Breakout Module shall audibly and visually indicate a fault.

10. The Speaker Breakout Module shall have a call-in roll-over feature where if a call-in to the primary call destination is not answered after a pre-set amount of time, the call shall be automatically copied to a secondary call destination. If both the primary and secondary call destinations are unavailable, the call shall be redirected to a back-up Console.

11. The Speaker Breakout Module shall have the capability to be configured as a member of one or more paging zones.

12. The Speaker Breakout Module shall have a built-in 4-watt audio amplifier that shall drive up to 4 watts of audio to a small zone of 25/70 volt loudspeakers. The Speaker Breakout Module shall provide a line level audio output that can connect to an external power amplifier for applications where the speaker zone load exceeds 4 watts.

13. The Speaker Breakout Module shall be monitored for network connectivity. If the Speaker Breakout Module 's network connection is lost, targeted Consoles shall report that station as absent and display its dial number. When the Speaker Breakout Module is used with Call Stations, the Speaker Breakout Module shall also provide full supervision and monitoring for Call Station and call-in destination connectivity. If a wiring fault is detected between a Call Station and the Speaker Breakout Module, the Speaker Breakout Module shall audibly and visually indicate the error utilizing the status LEDs on the Speaker Breakout Module. The Call Stations shall pulse their status LED to indicate a trouble condition. In case of a fault, the Management Interface or Logging Interface shall log the location, time, date and type of fault. If so configured, the Management Interface, Logging Interface, and Network Amplifiers shall also generate an alarm tone.

14. The Speaker Breakout Module’s status LED that shall flash in different patterns to indicate normal operation, call-in assurance, message-waiting, a call or paging audio in progress, or to indicate an error.

15. The Speaker Breakout Module shall be equipped with three relays that can be used to operate auxiliary devices such as strobe lights, tone initiating devices and door locks.

16. The Speaker Breakout Module shall be wall-mounted using the attached mounting brackets.

I. General Purpose I/O Device

1. The General Purpose Input/Output Device shall be a Telecor model eNODE or approved equal. It shall allow third party devices and systems to interface with Network Intercom and Paging System through contact closures.

2. The I/O Device shall have a minimum of 4 inputs and 4 outputs.

3. The inputs shall connect to dry relay contacts of third-party devices and shall activate any eSeries operations. Each input shall be configurable and shall support connection to sustained or momentary contact closures. Inputs shall differentiate between single or multiple momentary contact closures.

4. Outputs shall activate third party devices and systems. Outputs shall activate in response to:

   a. Paging Audio or intercom calls

   b. Scripts

   c. Alarms

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d. Events in the Master Clock / Message Host

e. Manual Dialing of a dial number

f. Analog Clock Correction

g. Trouble Status Indication

h. Service Mode

5. The I/O Device shall support tracking features where the output will automatically activate if the I/O Device detects the activation of paging audio, call-ins, Scripts and Alarms.

6. The I/O Device Output shall be capable of being manually dialed and activated from a console, or a phone on the facility's PBX. Once dialed, the caller shall be prompted by voice commands.

7. The I/O Device shall be integrated with the Master Clock/Message Host, allowing outputs to be activated according to scheduled events. The outputs can also be programmed to provide correction to synchronous movement analog clocks.

8. All I/O Device Inputs and Outputs shall be monitored and shall detect opens, shorts and ground faults on the connection between the third-party device and the I/O device. If any of these conditions are detected, a fault condition shall be raised on the system.

J. Supervised Network Administrative Console

1. The Administrative Console shall be supervised and allow the operator to establish two-way communications with an intercom station, talkback speaker, or another Console using the handset or speakerphone. VOX functioning shall be automatically enabled when the handset is used. The Push-to-Talk button shall toggle the Console between talk and listen mode when the speakerphone is used. The Console shall provide a 2-line by 20-character LCD display. The display shall be adjusted to a range of angles for optimum viewing. When there are no active calls, the display shall show the Console name and dial number. If a time server is connected to the network, the display shall also show the time and date.

2. Incoming calls to a Console shall show the originating station dial number and name on the Console display. Calls shall be displayed in the order they are received. The operator shall scroll through the list of calls and answer them out of sequence. Emergency call-ins shall be distinctly annunciated both visually and audibly.

3. The Console shall allow call-ins to be forwarded to another Console, or for calls to be put on hold or transferred to another Console location. Additionally, call-ins or calls shall be forward/transfer-able to PBX telephone extensions via a SIP trunk interface.

4. The Console shall select remote audio sources connected at any location on the local area network, and distribute the audio broadcast from the source to all speakers in a facility or to selected areas such as a speaker zone or a selection of speakers. The Console shall be capable of audio source verification by attendant prior to page zone activation. In this manner, attendants shall listen to the audio source locally, including listening to pre-recorded announcements, prior to system broadcast.

5. The Console shall select a tone or a pre-recorded announcement and broadcast the tone or announcement to all facility speakers or to select areas, such as a speaker zone or a selection of speakers.

6. The Console shall be equipped with digital volume control that shall allow for the

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separate adjustment of the speaker listen and handset listen volumes. The levels for intercom listen, tones, and program distributions shall be independently adjusted and stored in memory.

7. The system shall allow user programming of alphanumeric architectural room names and numbers. The Console shall be capable of using 1 to 7 digit sequences for dial out and call-in identification, and shall display station numbering, station name, and call-in priority.

8. The end-user shall be allowed to choose and determine the number and location of Consoles. The end-user shall not be limited by pre-set manufacturer limitations of the number of Consoles required by this project; allowing for unrestricted future expansion. Consoles may be added at any time. Consoles added by the end-user that exceed the engineered design for this project shall be at owner's expense. Communication between consoles or consoles and intercom stations or rooms shall not be inhibited by channel number restrictions.

9. The Console shall be capable of displaying room statuses such as Privacy and Do Not Disturb and shall have the ability to override any status limiting communication between the Console and a station with Privacy or Do Not Disturb status activated. Temporary override shall not interfere with continued activation of Privacy and Do Not Disturb after communication has been established and electively terminated.

K. Supervised Network Amplifiers

1. The Supervised Network Amplifier (subsequently referred to as Network Amplifier) shall provide a minimum of 25 watts for paging and public address and shall be capable of utilizing analog amplifiers to increase the amount of amplified signal from the network amplifier. The Network Amplifier shall be connected directly to the network switch by an RJ45 connector and shall receive signals directly from the network.

2. The Network Amplifier shall be supervised and in the event that network communications is lost, an audible alert shall sound on the Amplifier. The Network Amplifier shall provide a silence feature to mute the audible alert for 24 hours.

3. The Network Amplifier shall also be capable of receiving local input from local devices such as tape decks, iPod docks, CD players, etc. The network amplifier shall be capable of transmitting signals received from the local input to other network locations or locally to directly connected 25/70 volt or 8-ohm analog speakers.

4. Each Network Amplifier shall be capable of providing two audio inputs for local devices and shall be programmable as either a microphone or line-level input.

5. The Network Amplifier shall be controlled remotely such that audio programs, input, tones, textual messages, or announcements may be initiated by other devices connected at different locations on the local area network.

6. The Network Amplifier shall provide the ability to record and distribute a paging announcement to all zones or specific zones of loudspeakers in the system from a console. To utilize this feature the console operator shall dial an access code after which the operator shall be guided by voice prompts to select the zone and record the page. Once the page has been recorded the system shall distribute the page to the selected zone of loudspeakers.

7. The Network Amplifier shall have a minimum of 4 local tone/pre-recorded announcement audio message control lines which when activated will distribute tones/pre-recorded audio messages to intended network amplifiers for re-distribution, network talk-back speakers (or a zone), and/or local 25/70 volt or 8-

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ohm analog speakers directly connected to amplifier. Each network amplifier shall be capable of storing four (4) pre-recorded announcements in addition to a minimum of 16 tones. Tones and announcements shall be activated locally or from other network devices.

8. The Network Amplifier shall store and transmit companion textual messages for each stored audio announcements. Textual messages shall be automatically broadcasted to the same zones along with the audio messages such that any device programmed for that zone automatically receives both the audio and textual announcement/message and automatically reproduced each or both messages to the extent of the devices' capabilities.

9. The Network Amplifier shall be capable of transmitting HD level audio as defined by Intel™ High Definition Audio specifications, June 17th, 2010 at a minimum.

10. The Network Amplifier shall shut down to protect itself should an output short circuit fault or overload occur that jeopardizes the integrity of the Network Amplifier.

L. Power Amplifiers

1. Power Amplifiers shall be used to drive groups of speakers located in corridors and outdoor locations that are assigned to speaker zones. Amplifier Zones shall be sized at 1 watt per corridor speaker, and 3.5 watts per horn. The amplifier load shall not exceed 80% capacity.

2. The Power Amplifiers shall be capable of producing an audio output of 60, 125 or 250 watts RMS at less than 1% distortion with balanced output.

3. They shall be designed to operate on a line voltage of 115 AC.

M. Virtual Call Stations

1. The system shall include Virtual Call Stations that shall reside on classroom PC's as well as portable PC's that are used in classroom locations that are equipped with network speakers. Virtual Call Stations shall mimic the look and behavior of physical Call Stations. These shall feature interactive and animated buttons which react to user inputs such as mouse clicks or finger presses on touch screen devices.

2. Virtual Call Stations shall include Call Assurance indication via a virtual LED representation. When a call is placed the virtual LED shall blink to indicate that the call has been placed.

3. Virtual Call Stations shall be customizable to have any or all of the following configurations:

   a. Push to Call

   b. Emergency

   c. Privacy

   d. Do Not Disturb

   e. Channel Select

   f. Volume

   g. Alarm Acknowledgment

   h. Medical Alert

   i. Security Alert

   j. Panic Alert

4. Virtual Call Stations shall be configured with Volume buttons that shall adjust the

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volume in a room. Volume adjustments shall only affect the current active audio broadcast into the room, for example lowering the volume of paging announcements and not affecting the volume of intercom or emergency announcements.

5. When used with the Call Manager feature, Virtual Call Stations shall support Alarm Acknowledgement as well as Medical and Security Alert functionality. Alarm Acknowledgement functionality shall be used in conjunction with Alarm Manager operations to signal completion of emergency response instructions. Medical and Security Alert touchpoints shall activate a combined emergency response that shall initiate a priority call-in, as well as an audio broadcast and a scrolling text message on Message Displays.

6. Virtual Call Stations shall support Panic Alarm functionality and shall activate a panic level call-in to either the Panic Administrative Console or directly to 911 through eSIP Integration.

7. When used with portable PC's that are moved between locations, users shall be prompted to enter the room number of their current location.

8. The implementation of the Virtual Call Station shall be a client-server model. The server software shall reside in the Master Clock and Message host hardware. The client portion shall be installed on computers throughout the facility and connected to the facility network.

N. Supervised Message Display/Calendar Clock/Speaker Strobe

1. The Supervised Message Display/Calendar Clock/Speaker/Strobe Assembly (subsequently referred to as MDCSS Assembly), as indicated on the drawings, hall be a Telecor model e2444-LD or approved equal.

2. The MDCSS Assembly shall receive power and data over a RJ45 connect CAT5E/6 cable via a Power-Over-Ethernet switch port. Once plugged into the LAN through a Power over Ethernet network switch, the MDCSS shall be immediately functional and shall not require any network configuration or administration to function.

3. The MDCSS Assembly shall be supervised and monitored for connectivity to the network. Additionally, any Call Stations connected to the MDCSS shall be monitored for call line failure. In the event of an open circuit, short circuit or short to ground, the System shall detect the fault and notify a designated console operator automatically.

4. The MDCSS Assembly's Speaker shall have a power rating of 10 watts of audio signal and provide a minimum of 92db @ 1 meter SPL for maximum intelligibility.

5. The MDCSS Speaker shall provide transmission of HD audio as generated from intercom console and/or associated push-to-talk, intelligent microphone, supervised network amplifier, or program sources connected to the network.

6. The MDCSS Speakers shall support talkback; to optimize intelligibility talkback capabilities shall be supported.

7. The MDCSS Assembly shall support the direct connection with RJ45 connectors of two supervised room Call Stations. The stations shall provide the means for: normal calls, emergency calls, privacy mode, and do not disturb mode, as well as for the adjustment of Audio Volume. Call Stations shall include a call placed assurance status LED to indicate a call has been placed. Call Stations shall be supervised and immediately indicate disconnection or a wiring fault.

8. Emergency Call Stations shall be separate and clearly labeled with a red button so as to impart obvious operation in the event of an emergency. Systems that only provide a single call station with dual emergency and normal operation

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based on a sequence of button presses shall not be acceptable.

9. The MDCSS Assembly shall support Receivers which shall detect signals from Wireless Panic Buttons. When a signal is detected, the receiver shall initiate an emergency level call-in to the Administrative Console identifying the location of the call. The console operator shall immediately establish two way communications with the location that initiated the call

10. The volume of the MDCSS Speaker shall be adjusted individually, by zone, or across the entire network. Volume controls incorporated into certain Call Station models shall allow a user to adjust the volume of a local MDCSS speaker. Volume levels can be set for specific functions: intercom, paging, emergency paging, and Public Channel operations.

11. Volume controls shall be capable of establishing and maintaining levels for intercom, paging, program distribution, and tones, independently for each of the above functions. Emergency announcements shall not be affected by the adjustment of other speaker volume/levels such as paging, intercom, or other lower priority audio broadcasts. Systems that utilize a manually operated transformer or resistive volume control design shall not be acceptable.

12. The MDCSS Speaker shall have the capability to be configured as a member of one or more paging zones.

13. The MDCSS Assembly shall include an integral LED Strobe that shall illuminate for the duration of an announcement being broadcast over the MDCSS speaker to alert room occupants of the announcement in progress.

14. The LED Strobe shall be configured to illuminate in up to 4 colors (white, red, green or blue) with various flash patterns. Patterns can be set to activate based on the priority of announcements. For example, using a distinct color and flash pattern for an Emergency Announcement while a routine announcement or intercom call can be assigned another pattern and color.

15. The MDCSS Assembly shall include a Message Display/Clock that shall simultaneously display plain text emergency or routine messages and independent numerically-coded messages. When not displaying a message, it shall display the current time and date. Hours and minutes shall be displayed with large 2.25” digits. Seconds shall be slightly smaller for easy distinction. The date shall be displayed in plain text by a 10-character, dot matrix display showing the day of the week, followed by the month and date. The date shall be displayed in the English, Spanish or French language.

16. The Message Display/Clock shall automatically broadcast the audio announcement and a corresponding text message that is initiated on the over the communications system. These shall be enhanced by strobe illumination.

17. The Message Display/Clock shall also display text-only messages independent of any audio messages.

18. In addition to plain text messages, the Message Display/Clock shall also simultaneously display numerically-coded messages which can be activated independently to provide trained staff with additional context to the plain text messages.

19. The Message Display/Clock shall include elapsed timer and count-down functions. Used in conjunction with a Timer Button Panel, users shall set the Clock to count upwards from zero to 24 hours or count down from a specified value to zero. Additionally, the unit shall have a local input that will accept a relay closure to activate the elapsed or countdown timer operation. Timers embedded into pre-set plain text messages shall display messages for a pre-set period of time.

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20. All Message Display/Clocks shall be continuously synchronized to a Time Master connected anywhere on the same network Time corrections shall be performed instantaneously so that all Clocks display the correct time. If communication is lost with the Time Master, Clocks shall maintain the time independently and stay synchronized with each other. Once communication with the Time Master is re-established, the displays shall automatically resynchronize with the Time Master.

21. The MDCSS Assembly shall integrate with the Classroom Sound Field System and automatically mute the System during an intercom call, paging announcement or class change tone signal. Integration shall include the ability for an Emergency level call to be initiated from the Sound Field pendant microphone to the Administrative Console.

22. The MCDSS Assembly shall be equipped with 3 control relays to support integration with ancillary classroom devices. The relays shall be automatically activated during an emergency call-in or when receiving a broadcast or textual emergency message.

23. The LED strobe shall require Class 4, PoE+ power from the Network Switch.

24. The MCDSS Assembly shall be flush mounted using an e2444-BBF, or approved equal enclosure. In applications where surface mounting is required, an e2444-BBS or approved equal enclosure shall be provided.

O. Supervised Message Display/Calendar Clock/Speaker

1. The Supervised Message Display/Calendar Clock/Speaker Assembly as indicated on the drawings, shall be a Telecor model e2444 or approved equal.

2. The Assembly shall be identical to the Supervised Message Display/Calendar Clock/Speaker/Strobe Assembly as described in section 2.16 of the specifications, however it will not be equipped with the LED Strobe.

P. Digital Message Display/Calendar Clock

1. The Digital Message Display/Calendar Clocks, as indicated on the drawings, shall be a Telecor model e365-TB or approved equal. The unit shall simultaneously display the current time and date. The time is displayed in hours, minutes, and seconds. Hours and minutes are displayed with large 2.25” digits. Seconds are slightly smaller for easy distinction. The date is displayed in plain text by a 10-character, dot matrix display showing the day of the week, followed by the month and date. The date shall be displayed in the English, Spanish or French language.

2. The Digital Message Display/Calendar Clock shall receive power and data over a RJ45 connect CAT5E/6 cable via a Power-Over-Ethernet switch port. Once plugged into the LAN through a Power over Ethernet network switch, the Display shall be immediately functional and shall not require any network configuration or administration to function.

3. The Digital Message Display/Calendar Clock shall be supervised and monitored for connectivity to the network. Additionally, any Call Stations connected to the Display shall be monitored for call line failure. In the event of an open circuit, short circuit or short to ground, the System shall detect the fault and notify a designated console operator automatically

4. These Displays shall be designed for use in conjunction with the Master Clock/Message Host. All secondary clocks shall be synchronized with the Master Clock. Corrections shall be done instantaneously and all clocks shall display the identical time and date. In the event of a power failure, the System shall maintain accurate timekeeping during the outage. Once power is restored, all clocks shall be immediately updated with the correct time and date.

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5. In addition to displaying the time, the Unit shall display textual messages in the dot matrix section of the display to the audio announcement that is being broadcast over the communication system speakers. These messages shall be used to alert personnel of an emergency or a situation of concern.

6. The Unit shall also display text-only messages independent of any audio messages.

7. In addition to plain text messages, the Digital Message Display/Calendar Clock shall also simultaneously display numerically-coded messages which can be activated independently to provide trained staff with additional context to the plain text messages.

8. The Digital Message Display/Calendar Clock shall include elapsed timer and count-down functions. Used in conjunction with a Timer Button Panel, users shall set the Clock to count upwards from zero to 24 hours or count down from a specified value to zero. Additionally, the unit shall have a local input that shall accept a relay closure to activate the elapsed or countdown timer operation. Timers embedded into pre-set plain text messages shall display messages for a pre-set period of time.

9. Messages shall be programmed using the Editor software or from a web based Graphical User Interface (GUI). Messages can be activated by the Master Clock/Message Host, allowing text to be displayed at specific times and days of the week. Messages shall be displayed using a variety of visual effects including scrolling or flashing single lines of text, as well as alternating between different lines of text. The dot matrix display shall default back to the date when not displaying messages.

10. The Digital Message Display/Calendar Clock shall be suitable for surface or recessed installations using the appropriate enclosure. For surface installations, the 2431-BBS enclosure is required. For recessed installations, the 2431-BBF enclosure is used. Two surface-mount enclosures shall be mounted back-to-back with a 2423 Dual Mounting Kit, creating a double-faced version.

Q. Supervised Network Intercom Talk Back Speaker

1. The Supervised Network Intercom Talk-Back Speaker (subsequently referred to as Network Speaker) shall be a Telecor model eS8-TB. The Network Speaker shall be supervised and capable of up to 10 watts of audio signal and provide a minimum of 92db @ 1 meter SPL for maximum intelligibility. Speaker spacing shall be as defined by manufacturer to provide maximum intelligibility.

2. The Network Speaker shall provide transmission of HD audio as generated from intercom console and/or associated push-to-talk, intelligent microphone, supervised network amplifier, or program sources connected to the network.

3. The Network Speaker shall provide a dry contact output that can be activated remotely from a station or from a console, such as may be required in a door release application.

4. The Network Speaker shall receive power and data over a RJ45 connect CAT5E/6 cable via a Power-Over-Ethernet switch port. Once plugged into the LAN through a Power over Ethernet network switch, the Network Speaker shall be immediately functional and receive calls and pages from consoles on the network. The Network Speaker shall not require any network configuration or administration to function.

5. The Network Speakers shall support talkback; to optimize intelligibility talkback capabilities shall be supported via a microphone conditioned for low noise, HD audio, and with compression and noise gate capability. Stations that use the speaker instead of a separate microphone for talkback capability shall not be

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accepted.

6. The Network Speaker shall have a call-in roll-over feature where if it places a call-in to a primary call destination which is not answered after a preset amount of time, the call-in shall be automatically escalated to a secondary call-in destination. If both the primary and secondary call-in destinations are unavailable, the call-in shall be redirected to a back-up Station, Console, or telephone device.

7. The Network Speaker shall have the capability to be configured as a member of one or more paging zones.

8. The Network Speaker shall support the direct connection with RJ45 connectors of two, supervised room notification stations. The stations shall provide the means for: normal calls, emergency calls, privacy mode, and do not disturb mode. Notification stations shall include a call placed assurance status LED to indicate a call has been placed. Notification stations shall be supervised and immediately indicate disconnection or a wiring fault.

9. In addition to the visual call-in assurance status indicators on the notification stations, call-in assurance status indication must also be provided on the associated speaker. Also, in addition to visual call-in assurance, audible call-in assurance shall also be provided in support of persons with visual disabilities.

10. Under blackout conditions, the notification station shall be illuminated such that it can be located in the dark.

11. Normal call stations must support the ability to activate emergency call-in signals via multiple button presses and press and hold operations. Emergency call stations shall be separate and clearly labeled with a red button so as to impart obvious operation in the event of an emergency. Systems that only provide a single call station with dual emergency and normal operation shall not be acceptable.

12. The Talk Back Speaker shall support Receivers which shall detect signals from Wireless Panic Buttons. When a signal is detected, the receiver shall initiate an emergency level call-in to the Administrative Console identifying the location of the call. The console operator shall immediately establish two way communications with the location that initiated the call.

13. The Network Speaker shall provide local, visual indication of operation or failed-communication and shall immediately annunciate a loss of communication at the main console location.

14. Network Speaker volume must be capable of individual level settings through the network. Settings must not be adjustable without authorization. Volume controls located in rooms must be centrally lockable via the network. Systems that allow a volume adjustment without authorization shall not be acceptable. Systems that utilize a manually operated transformer or resistive volume control design shall not be acceptable. Volume controls shall be capable of establishing and maintaining levels for intercom, paging, program distribution, and tones, independently for each of the above functions. Emergency announcements shall be sent at a volume/level as required by the AHJ and shall not be affected by the adjustment of other speaker volume/levels for the purposes of paging, intercom, or other lower priority audio events.

R. Supervised Network Master/Satellite Talkback Speaker

1. The Supervised Network Master/Satellite Talkback Speaker (subsequently referred to as the Master Talkback Speaker) shall be a Telecor model eS8-TB4 or approved equal. The Master Talkback Speaker shall support all functionality of the Telecor model eS8-TB (specified above).

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2. The Master Talkback Speaker shall be supervised and shall support the connection of Satellite Speakers, and support up to four watts of additional 25V Satellite Speaker load. Satellite Speakers shall be Telecor model S8T2570 or approved equal.

3. The Satellite speakers shall not support talkback; to optimize intelligibility talkback capabilities shall be supported from a single point via a microphone conditioned for low noise, HD audio, and with compression and noise gate capability. Stations that use the speaker instead of a separate microphone for talkback capability shall not be accepted.

4. The Satellite Speaker shall receive power over a RJ45 connect CAT5E/6 cable via the Supervised Network Master/Satellite Talkback Speaker. Both the Supervised Network Master/Satellite Talkback Speaker and the Satellite Speaker shall receive all power through a single Power-Over-Ethernet switch port. Systems that require auxiliary power or additional external or supplementary audio power amplification are not acceptable.

S. Staff Telephones

1. The Staff Telephones as indicated on the drawing shall be Telecor model HS1301 or approved equal.

2. They shall be capable of direct-dialing, two-way communications between any location equipped with Administrative Control Consoles or other Telephone.

3. Staff Telephones shall be capable of initiating paging announcements to specific paging zones or on an all call basis. Access to paging shall be restricted with a dial access code.

4. Locations equipped with Network speakers and Staff Telephones shall include a “take-over” function. This function allows the party participating in an open voice intercom call over the speaker, to pick up the Telephone handset, dial an access code, where-by the system will automatically transfer the call from the speaker to the telephone handset. Systems that require party to terminate the call and redial from the Telephone will not be accepted.

5. The Staff Telephones shall be a standard utility grade instrument, equipped with automatic side tone balancing networks, electret transmitters and dynamic receivers. A receiver Volume control shall be provided on the side of the telephone base allowing for the adjustment of the handset listen level. The telephone housing and handset shall be manufactured from a high impact plastic.

6. Staff Telephones shall be equipped with a standard 12-Button Dial Keypad, along with 4 special function buttons (Store, Recall, Save and Flash), 3 one touch Priority Dial buttons and a re-dial button.

T. Analog Clocks

1. The Analog Secondary Clock shall be Telecor eACLK Series or approved equal. Clocks shall l be designed to reside on a facility’s data network. The clocks shall use Power-over-Ethernet technology, and a decentralized network structure to ensure easy wiring and simplified network planning. The use of Power-over-Ethernet technology shall allow the Analog Clock to be plugged into a PoE network switch to receive both power and data. The Analog Clock shall not require any network configuration or administration, eliminating IP address and DHCP server requirements.

2. All Analog Clocks on the LAN shall be continuously synchronized to a Telecor Time Service connected anywhere on the same network. The Time Service shall be from a Telecor ePORT Management Interface, eCI Control Interface, eLOG Logging Interface, eSIP Interface, eMH Master Clock and Message Host, or a PC running Telecor Ethernet Time Server Software. Time corrections shall be

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performed instantaneously so that all Analog Clocks display the correct time. If communication is lost with the Time Service, the Analog Clock shall maintain the time independently but stay synchronized with each other. Once communication with the Time Service is re-established, the Clock shall automatically resynchronize with the Time Service

3. The Analog Clock shall connect to a PoE port at a network switch. Up to two single-face clocks or one dual-face clock shall be supported from a single network port.

4. Analog clocks shall be equipped with a second hand to mark the fractions of a minute as well as minute and hour hands.

5. Analog Clocks shall be available in either a 12” or 16” dial size. Clocks shall be single or dual face models suitable for wall or ceiling mounting. Specific sizes and models are noted on the building floor plans.

6. A single Analog Clock shall be capable of supporting an eSeries Speaker, or an additional eACLK Analog Clock from a single network drop. The additional device shall be connected to the eACLK with up to 328 feet (100 m) of CAT-5 or higher cable.

7. The speakers that shall be supported by the Clock include: a paging-only eS8-MA speaker, an eS8-TB-MA Talkback Speaker, an eS8-TB4-MA Talkback Master Speaker with additional satellite speakers, or an eSBM-TB Speaker Breakout Module. In addition, the eSeries speaker shall support normal and emergency Call Stations and auxiliary devices such as strobe lights, tone initiating devices and door lock. Systems that require 2 network drops, one for the analog clocks and one for the Room speakers shall not be accepted.

8. The clocks shall be housed in a low profile, semi flush steel case.

U. Digital Clocks

1. The Digital Clocks shall be Telecor model eCLK-2.5 / eCLK-4 or approved equal.

2. The eCLK-2.5 shall incorporate a 2.5" display and located as indicated on the drawings. It shall be suitable for surface or recessed installations using the appropriate enclosure. For surface installations, the 2421-BBS or approved equal Enclosure shall be used. For recessed installations, the 2421-BBF or approved equal Enclosure shall be used.

3. The eCLK-4 shall incorporate a 4" display and located as indicated on the drawings. It shall be suitable for surface or recessed installations using the appropriate enclosure. For surface installations, the 2431-BBS or approved equal Enclosure shall be used. For recessed installations, the 2431-BBF or approved equal Enclosure shall be used.

4. The Digital Clocks shall utilize seven-segment, AlGaAs “Supper Bright” LED displays which provide exceptional visibility. The Clocks shall incorporate a single piece front cover that is free of grooves and gaps. This shall keep infectious contaminants out of the eClock. The cover's non-porous surface shall allow for easy, comprehensive, hygienic cleaning with anti-bacterial agents.

5. The Digital Clocks shall receive power and data through a Power-Over-Ethernet switch. The Digital Clocks shall not require any network configuration or administration to function. Once plugged into the LAN through a Power over Ethernet network switch, the Digital Clocks shall be functional.

6. These Displays shall be designed for use in conjunction with the Master Clock/Message Host. All secondary clocks shall be synchronized with the Master Clock. Corrections shall be done instantaneously and all clocks shall display the identical time and date. In the event of a power failure, the System shall maintain

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accurate timekeeping during the outage. Once power is restored, all clocks shall be immediately updated with the correct time and date.

7. Two surface-mount enclosures shall be mounted back-to-back with a 2423 Dual Mounting Kit, creating a double-faced version.

V. Wall Mount IT Cabinets

1. The Wall Mount Cabinet shall be a Telecor cabinet model insert eCAB-9U-H or eCAB-12U-H or approved equal. The Cabinet shall have insert 9 or 12 RU Panel space for mounting 19”W EIA standard equipment.
2. The Cabinet shall include a safety glass front door with a security lock to prevent tampering with equipment.
3. Cabinet shall be constructed to swing open for cabling access. The center section shall pivot left or right. The wall mounting section shall attach to the main section using heavy duty hinges. Triangular position brackets shall guide the main section cabinet to ensure proper alignment.
4. The Cabinet’s center section shall include adjustable front and rear mounting rails with mounting hardware. Usable Depth for equipment inside the Cabinet shall be 18”.
5. The Cabinet shall include removable side panels to allow easy access to the enclosed equipment for installation and service. The panels shall be lockable and keyed differently from the locking center section for security.
6. Fan cut outs on the top of the cabinet shall allow for installation of ventilation fans. Additional cut outs for cable entry are provided at the top and bottom of the wall mount section.
7. The Cabinets shall be finished using RAL 9005 black, fine wrinkle, soft touch epoxy coating, providing an attractive durable finish.

2.4 AMPLIFIER AND LOUDSPEAKERS:

A. Audio Paging/Program Amplifiers: Atlas Sound – CP400, Powersoft – Mezzo 322 A, Stewart Audio – CVA25-1 70V, and/or Manufacturer’s equivalent.

1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging loudspeakers, and 15 watts of power to all paging horns.
2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.
3. Provide 25 or 70 volt transformer output for all zones that connect more than 3 loudspeakers together and/or the distance from amplifier to the loudspeaker is greater than 25’.
4. Any exterior zone shall be connected to a minimum of 200 watt amplifier channel.

B. Loudspeakers:

1. Telecor, AtlasIED, and Quam loudspeaker assemblies are the basis of design. Intercom manufacturer equivalent loudspeakers are allowed if they meet the function and form of the loudspeakers listed below.
2. Loudspeaker cabling for common zones shall use a 16 AWG 2-pair stranded conductor cable assembly unless otherwise noted. Refer to Audiovisual Cable and Conduit Schedule on the drawings for approved cabling manufacturer.
3. Type ‘IC1’ - loudspeaker assembly:
   a. Telecor – STB-12 or equal
   b. 2’x2’ ceiling tile replacement loudspeaker with 5 oz. magnet and 5 watt 25/70V transformer. 93dB SPL 1W/1M. 65Hz – 17kHz frequency response ±3dB and 100-degree dispersion angle.
4. Type ‘IC2’ - loudspeaker assembly:

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a. Atlas – SD72W w/ 76-8 mounting ring and BMTT95-8 enclosure
b. Quam – C10X/BU/WS w/ SSB-7 mounting ring and ERD-8U enclosure
c. Manufacturer equivalent
d. Gyp loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response ±3dB and 90-degree dispersion angle.

5. Type 'IC3' - loudspeaker assembly:
   a. Atlas – SD72W w/ BMTT95-8 enclosure
   b. Quam – C10X/BU/WS w/ ERD-8U enclosure
   c. Manufacturer equivalent
   d. Open ceiling direct mount to structure loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response ±3dB and 90-degree dispersion angle.
6. Type 'IC4' - loudspeaker assembly (lay-in tile IP);
   a. Intercom Manufacturer specific assembly with an IP Addressable module and loudspeaker.
7. Type 'IW1' - loudspeaker assembly:
   a. Quam – 8C5PAX/TBLU w/ ES-8 enclosure and BS8W grill
   b. Indoor recessed wall 8" loudspeaker with 5 oz. magnet and 5 watt 24/70V transformer. 92dB SPL 1W/1M with 99dB max SPL at maximum tap. 65Hz – 17kHz frequency response ±3dB and 100-degree dispersion angle.
8. Type 'IW2' - loudspeaker assembly:
   a. Atlas – VTF-152UCN or VTF-157UCN w/ AR Adapter Ring
   b. Exterior recessed wall 4" loudspeaker with 5 watt 24/70V transformer. 96dB SPL 1W/1M with 107dB max SPL at maximum tap. 600Hz – 5.5kHz frequency response ±5dB and 170-degree dispersion angle.
9. Type 'IW3' loudspeaker assembly:
   a. Atlas – AP-15T
   b. Exterior Horn with compression driver and 15 watt 24/70/100V transformer. 106dB SPL 1W/1M with 120dB max SPL at maximum tap. 400Hz – 14kHz frequency response ±5dB and 70-degree dispersion angle.
10. Type 'IW4' loudspeaker assembly:
    a. Atlas – AP-15T
    b. Exterior Horn with compression driver and 15 watt 24/70/100V transformer. 106dB SPL 1W/1M with 120dB max SPL at maximum tap. 400Hz – 14kHz frequency response ±5dB and 70-degree dispersion angle.

C. UPS – Juice Goose – SCV-30001 or equal

1. Contractor to verify UPS load requirements prior to purchase of UPS. Intercom system shall maintain power for 30 minutes after building loses power.

D. Cabling:

1. Provide and install appropriate number of analog and horizontal cables, patch cables, for all terminated data drops, between switches, etc. so that building-wide networking will be operational once all installation is complete.
   a. Provide manufacturer recommended cabling for all locations shown on plans.
      i. Horizontal/Category provided per specification 27 1500 (i.e. IP addressable Speakers, Classroom Modules, Call Switches, Zone Modules, Console, Controller, etc.)
      ii. Loudspeaker cabling shall be 18 gauge or better. Refer to drawings for cable types and requirements.

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b. Provide cabling rated for the environment that it is installed in (i.e. underground conduit, conduit in slab on grade). All cabling installed in wet locations shall be listed for use in wet locations.

2. All associated intercom wiring cable shall be yellow.
   a. All network lines will be yellow with yellow keystones on separate punch panels. The intercom system will be on a separate network.

E. Clocks:

1. Clocks shall be battery powered (24-V). The contractor shall provide a fresh battery and install each clock set to the correct local time. Room types will have different size requirements.
2. 16" clock – Telecor – 2463-A-24
   a. Provide 1 clock per the following room types:
      i. Classrooms
      ii. Collaboration Areas
      iii. Offices
      iv. Workrooms
      v. Conference rooms
      vi. Gymnasiums (provide 1 on each side of the dividing curtain)
      vii. Music room
      viii. Mechanical/Shops
      ix. Kitchen
      x. Commons/learning stairs
      xi. Media center
3. Provide wire guard on all clocks in locations where other devices are protected (i.e., gymnasium). Coordinate with fire alarm plans for locations requiring wire guards.
4. Provide one “All-in-One Alert Display” in the administration area as indicated on the plans.

2.5 ZONES, PROGRAM DISTRIBUTION, CLOCK/TIME SIGNALING SYSTEM

A. Separately addressable paging zones shall be provided as indicated on the drawings. Zones shall be capable of being grouped for various call scenarios as defined or requested by the owner.

B. Refer to the intercom drawings for identification of zones, zone types, and ceiling construction type.

1. Individual zones are designated with “Z-ID”.
2. Common and exterior distributed zones are identified with a unique zone number “Z-#X#”.
3. Intercom drawings are intended to be printed in color in addition to having the zone information under the room tag.

C. Space requirements:

1. Classrooms/Teaching spaces.
   a. The IP module/loudspeakers for each space shall be utilized for the intercommunication system.
   b. One (1) Call switch shall be provided in each room near the CSA antenna location. Refer to drawings for location of devices.
   c. One (1) Clock located above the entrance door.
2. Shared spaces between Classrooms/Teaching spaces.
   a. The IP module/loudspeakers for each space shall be utilized for the intercommunication system.
   b. One (1) Call switch shall be provided on the wall adjacent to the main hallway.

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c. One (1) Clock located above the entrance door.
d. These rooms will be used as shelter in place rooms for adjoining classrooms.

3. Specialty Teaching spaces with high ambient noise floor (Wood/Metal/AG shops, Band/Choral/Orchestra rooms, etc).
   a. Distributed ceiling recessed loudspeakers (Qty. as required) at 14' by 14' minimum spacing, type as required for ceiling construction.
   b. Visual strobe located in a highly visible area.
   c. One (1) Call switch shall be provided at the primary teaching station. Coordinate location of primary teaching location with drawings.
   d. One (1) Clock located above the entrance door
4. Private Offices, Conference rooms, Faculty Lounges & Work Rooms (outside of the main office/administration suite)
   a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.
   b. Connect to adjacent corridor zone you enter the office from.
   c. Offices off of a classroom shall be on the same zone as the classroom.
   d. Refer to floor plans for offices that require an individual zone.
5. Gymnasium
   a. Wall mounted horn type loudspeaker above the entrance door. If there is a dividable curtain provide a loudspeaker for each side along with one on the stage, if applicable.
   b. Additional loudspeakers may be required as needed to maintain adequate coverage (< 6dB level variation).
   c. One (1) Call switch shall be provided co-located with any light switches adjacent to each entrance from within the school.
6. Cafeteria/Commons/Dining
   a. Ceiling mounted loudspeakers, Qty. and type as required for ceiling construction and adequate coverage (< 6dB level variation).
7. Kitchen
   a. Ceiling mounted loudspeakers, Qty. and type as required for ceiling construction and adequate coverage (< 6dB level variation).
   b. One (1) Call switch shall be provided co-located with any light switches adjacent to main entrance.
   c. Within the Kitchen office provide a two-way system with call button and loudspeaker.
8. Corridors, Vestibules & Open Collaboration/Circulation areas
   a. Distributed ceiling recessed loudspeakers (Qty. as required) at 20' minimum spacing, type as required for ceiling construction.
   b. Rooms that are wider than 25' shall require an additional row of loudspeakers and located on a maximum of a 20' x 20' spacing centered in the room.
   c. Coordinate with ceiling devices and locate adjacent to smoke detectors when within few feet of one. Loudspeakers shall be in line with any lighting within the space
   d. Provide a minimum of one (1) loudspeaker for each space type
9. Stairwells
   a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.
   b. Connect to the adjacent corridor zone unless otherwise specified.
10. Restrooms
   a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.
   b. Connect to the adjacent corridor zone

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c. Do not provide loudspeakers in single use restrooms adjacent to a corridor zone. Locate corridor loudspeakers within 10 to 12 feet of the door.

11. Administration Suite (Private offices, Conference rooms, Nurse areas, work rooms, reception, etc. within the main administration suite)
    a. Distributed ceiling recessed loudspeakers (Qty. as required) at 20' minimum spacing down corridors and 14' x 14' in open areas, type as required for ceiling construction.
    b. Provide a minimum of one (1) loudspeaker for each space type.
    c. Provide a minimum of one (1) loudspeaker on an individual zone in the reception area and adjacent areas where it would be heard in the reception area. General pages from the reception area shall not play over this zone, it shall only be used for prerecorded messages.
12. Building Exterior
    a. Distributed recessed loudspeakers (Qty. as required) to cover all sides of the building and all entrances.
    b. Coordinate and co-locate loudspeaker rough-in with exterior fire alarm horn strobe locations.
    c. Provide unique zone for each side of the building (North/South/East/West)
    d. Provide 'IW3' type loudspeakers on areas with:
        i. Playground equipment
        ii. Fields
        iii. Other play surfaces
    e. Provide 'IW2' type loudspeakers on the front of the building and in locations where the property line is less than 30' from the building.
13. Rooms smaller than 100 sqft and that are adjacent to a corridor/hallway will not require a loudspeaker when an announcement is audible within the room. Audible within the room shall be defined as 15 dB above the ambient noise within the room.
    a. Vestibules are excluded from small rooms and will require a loudspeaker tied to the adjacent corridor zone.
14. Field coordinate the tap setting on each loudspeaker to be 15dB above the ambient noise floor. The ambient noise floor shall be measured when the area is fully occupied. The following areas have the anticipated noise floor:
    a. Hallways – 80 dB
    b. Classrooms – 70 dB
    c. Offices/conference rooms – 60 dB
    d. Gym/multipurpose rooms – 85 dB
    e. Exterior areas – Max tap setting

D. All class-change bell signaling shall be sounded over the intercommunication system.

1. Each dialing administrative console in the system shall be programmable for the following options:
    a. Allow zone paging.
    b. Allow All-Page announcements.
    c. Allow Executive Override.
    d. Allow Emergency paging.
    e. Allow activation of Time Zone tones.
    f. Set the priority level and target display of "normal" calls.
    g. Set the priority level and target display of "emergency" calls.
    h. Assignment of architectural number.
    i. Class of Service.
    j. Assignment of associated speaker to paging zone.
    k. Automatic Call-Back-Busy.
    l. Call Forward-No Answer.
    m. Call Forward-Busy.

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n. Allow activation of security monitoring functions on a per room and per zone basis.

E. All class-change signaling shall be sounded over system loudspeakers as programmed.

PART 3 - EXECUTION

3.1 GENERAL

A. Wiring shall be installed in metallic conduit to cable trays and provided with necessary junction and pull boxes. All wiring shall be color coded and in accordance with the manufacturer's instructions, local and national codes. Care shall be exercised in wiring to avoid damage to the cables. All boxes shall be plumb and square. Cables shall be pulled continuous without splicing, leaving ends in lengths as directed by the manufacturer's representative.

B. After all circuits and cables have been pulled and completed from one extremity to the other, the electrical contractor shall check all circuits free of opens, shorts and grounds. The electrical contractor shall identify and tag all cables at the head end.

C. Provide all equipment, wiring, conduit, boxes, rough-in, etc., according to the plans and specifications.

D. The manufacturer's representative shall make all final connections to the equipment, shall test and adjust the systems, and shall instruct the proper parties as to care and operation.

E. Any additional equipment required for a fully functional system to meet the intent of the specifications shall be provided whether or not specifically listed herein.

F. Mount punch down block for system terminations, within the equipment rack.

G. Test the reception at each clock location, per manufacturer's instruction, to determine the actual location with the Architect.

3.2 INSTALLATION OF SOUND SYSTEMS:

A. Install sound systems as indicated, in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with requirements of NEC and applicable portions of NECA's "Standard of Installation" practices.

B. Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

C. Coordinate with other electrical work, including cable/wire, raceways, electrical boxes and fittings, as appropriate to interface installation of clock and program systems work with other work.

D. Control Circuit Wiring:

1. Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
2. The contractor shall mount a main distribution frame behind the Integrated Electronic Communications Network console. All wires shall be laid down on terminal punch blocks and identified by the actual room location it serves. All the communications points shall be wired into this main distribution frame, laid down in sequence, and identified by which line it is on and the point position it serves.
3. All housings are to be located as specified and shown on drawings.
4. Make installation in strict accordance with approved manufacturer's drawings and instructions.

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5. The contractor shall provide necessary transient protection on the AC power feed, all station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.

E. Wiring Within Enclosures:

1. Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
2. Provide physical isolation from each other for speaker-microphone, line-level, speaker-level, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones and adjacent parallel power and telephone wiring. Provide physical separation as recommended by equipment manufacturer for other Integrated Electronic Communications Network system conductors.

F. Weatherproofing:

1. Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.

G. Equalize systems using industry recognized practices and equipment.

H. Pathway Requirements:

1. General:
   a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.
   b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Arrangements to remove any major obstructions not identified on plans need to be determined at that time with the Engineer.
2. Conduits:
   a. Contractor shall provide a minimum of 1-1” EMT conduit from device to accessible ceiling space unless otherwise noted. Then utilize non-continuous cable support from devices to connecting device. Refer to symbol schedule for specific conduit requirements.
      i. Provide non-continuous open top cable supports every 5’ above accessible ceiling.
   b. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
   c. Provide large radius elbows on all bends.
   d. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.
   e. AV conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.
   f. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.
   g. A 200lb pull cord (nylon, 1/8” minimum) shall be installed in any empty conduit.
3. Open Top Cable Support Requirements:
   a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables
   b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

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4. Pull Box Requirements:
   a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.
   b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.
   c. Conduits that enter a pull box from opposite ends should be aligned.
   d. Pull boxes shall have a length 12 times the diameter of the largest conduit.
   e. All pull boxes must be accessible.

I. Cabling System:

1. Follow T568B scheme for copper category cabling terminations.
2. Provide a minimum 6” service loop in each AV system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.
3. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.
4. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
5. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for AV cable is required, the contractor shall install appropriate carriers to support the cabling.
6. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
7. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
8. Pair untwist at the termination shall not exceed 0.125”. The cable jacket shall be maintained as close as possible to the termination point.
9. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.

J. Cabling groups and conduit separation:

1. Refer to “CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE”.

K. Firmly secure all equipment in place that is not intended for portability.

L. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.

M. Provide adequate structural support for AV system components. Provide fastenings and supports with a safety load factor of at least five.

3.3 GROUNDING:

A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

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C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

D. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.

E. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.

F. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.

G. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.

H. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.

I. Refer to electrical diagrams for additional ground connection requirements.

3.4 LABELING

A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size and color.

C. Provide laminated plans (minimum size 11x17) of all AV as-built plans (including riser diagrams) intercom rack. Contractor shall be responsible for providing a 1RU drawer.

D. Label each equipment with the date (month/year) that it was installed along with the IP address, if applicable, and equipment type.

3.5 CYBER SECURITY

A. Contractor shall change all default username and passwords for all network devices provided. A Strong Password should include at a minimum the following:

1. Be at least 12 characters in length
2. Contain both upper and lowercase alphabetic characters (e.g. A-Z, a-z)
3. Have at least one numerical character (e.g. 0-9)
4. Have at least one special character (e.g. ~!@#$%^&*()_-+=)
5. Cannot contain full words

B. No written username or passwords shall be located in any areas of installation.

C. Network devices to be set up on a separate network other than owner's LAN ensuring no internal or external users can access system without authorization.

D. Follow manufacturers hardening guide and use best industry practices to secure network and devices provided by contractor and associated with system.

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3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Inspection:

1. Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
2. The installation technician from the installer / manufacturer shall perform all system tests as specified. Perform all tests in the presence of the Owner, Architect / Engineer and any designated personnel as deemed necessary by the Owner or Architect / Engineer. This test shall be performed with the devices at their operational location and under normal operational conditions. Bench or default settings for devices are not acceptable. All test and test report costs shall be included in the contractors bid. A checkout report shall be generated by the installation technician and submitted to the Owner and Architect. The report shall include but not be limited to the following:
    a. A complete list of all equipment installed with corresponding serial numbers.
    b. Indication that all equipment is properly installed, functions and conforms to the specifications.
    c. Serial numbers, locations by device and model number for each installed device.
    d. Technician’s name, specified certification credentials and date of system test.
    e. Any additional information as deemed necessary by the Owner and or Architect / Engineer.

C. TESTING:

1. Upon completion of installation of each system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units on site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.
2. Before inspection by owner and AV Consultant, and after completion of the installation, conduct system tests and make necessary corrections for proper system operation.
3. Adjust, balance and align equipment for optimum quality and to meet the manufacturer’s published specifications.
4. All limiters and/or compressors shall be set to prevent operators from over-adjusting sound levels and damaging system components.
5. System shall have no audible hum, noise, RFI, or distortion when operating under normal conditions. System shall reproduce material at the loudspeakers rated output level without audible distortion. All input levels shall be pre-set so system may be operated without causing unstable feedback under normal use.
6. System shall have no image distortion, hum bars, color shift, or any other picture distortion while operating under normal conditions. Provide cable equalizers, located near displays, on all cables that are more than 30 feet in length and/or have more than 4 connection points.
7. Adjust gain controls for optimum signal-to-noise with 0 dBu at a line-level input.
8. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.

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9. Loose parts and poor workmanship or soldering shall be replaced.
10. Sweep Loudspeaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to Loudspeakers or enclosures. Notify owner of external causes of buzzes or rattles.
11. Contractor shall provide system testing as described herein using up-to-date and industry accepted test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1.
12. Horizontal cabling contractor shall test all twisted pair cabling used within the system following the standards in specification 27 1500 under the testing section. Provide documentation of testing to Intercom Consultant prior to final walk through.

D. At the time of final commissioning, if the Intercom consultant determines that the systems are not sufficiently complete to do a final punch list, and was not notified at least three (3) days prior to the visit, then a return visit will be required. The Intercom Consultant's return visit will be paid for in advance by the Intercom integrator at a flat rate of $3,000 per person, at no cost to the owner.

3.7 OCCUPANCY ADJUSTMENTS:

A. When requested by the Architect within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions.

3.8 TRAINING

A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.

B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.

C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received and completed the training program.

D. Provide a minimum of two (2) six (6) hour sessions of in-service training with this system. These sessions shall be broken into segments that will facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided at the time of this training.

E. Schedule training with Owner through the Architect, with at least fourteen (14) days advance notice.

F. Training shall be recorded using a video recording device that support a minimum resolution of 1080P/60 with an integrated microphone connection for an external microphone and a camera tri-pod mount. Presenter shall be wearing a lapel microphone that connects to the recording device and a Tri-pod shall be used for stabilizing the recording device. Recordings that are shaky, poor audio and/or video quality, incomplete, or other issues will not be accepted and the contractor will be responsible for providing a new recording and training within five (5) business days of notification. Provide a digital copy to the Owner and Intercom Consultant. If Digital copy is sent in a link, verification of end user download shall be provided to the owner and Intercom Consultant showing IP address or user that download and what date. The link cannot have an expiration date and will be the responsibility of the contractor to maintain. Links shall be included in the Operating and Maintenance manuals in the first section. Video files shall also be provided on a flash drive within the intercom equipment rack adjacent to the server location. Flash drive shall be clearly labeled.

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3.9 CLEANING AND PROTECTION

A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up.

3.10 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

3.11 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 5123

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SECTION 27 5320

PUBLIC SAFETY DAS/ERRCS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 26, 27, and 28, Specification Sections, apply to this Section.

C. Refer to Appendix A – Hyde Park ES ERRCS/DAS System Preliminary Design

D. 28 3111 Fire Detection and Alarm System

1.2 ADMINISTRATIVE REQUIREMENTS:

A. BNA Project Contact:

1. Drayton Bailey – Principal
   a. Phone: 801-532-2196
   b. Email: drayton@bnaconsulting.com

B. Bid Submittal:

1. Equipment Costs: Breakout cost of material and labor as different line items. Refer to bid form for breakout cost requirements.

C. Coordination:

1. Coordinate final inspection of the systems installed, with Emergency Responders Radio Communication System (ERRCS) Consultant, three (3) weeks in advance.
2. Obtain GANTT chart for construction time frame from the General Contractor.
3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted ERRCS equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted ERRCS equipment in each area.
4. Meet with Electrical contractor prior to pathway rough-in to coordinate ERRCS requirements in each area.
5. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all ERRCS network requirements. Coordinate cable color according to specification 26 0553.
6. Coordinate color and finish of all ERRCS components with Engineer.

D. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.

E. ERRCS contractor shall participate in a mandatory pre-construction meeting no more than sixty (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating the meeting. The meeting will be held at job trailer. All submittals, shop drawings and bills of materials shall be completed and submitted to Consultant for review eight (8) working days prior to this meeting.

F. ERRCS contractor shall attend the electrical pre-construction meeting per specification 26 0500.

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1.3 GENERAL SYSTEM REQUIREMENTS

A. Public Safety DAS/ERRCS

1. SUMMARY: This specification describes technical and performance criteria for deploying an Emergency Responders Radio Communication System (ERRCS) capable of supporting Public Safety Networks (PSN). Contractor shall provide a full turn-key solution and installation of the ERRCS as indicated per specifications.
2. Division 26 and/or DAS Contractor is responsible for including all required contractors bids. Division 26 contractor is responsible for all pathway, power, and grounding requirements necessary for DAS system.
3. 700/800 MHz ERRCS (Emergency Responders Radio Communication System)

B. The DAS components typically specified include:

1. Bi-Directional Amplifiers (BDA)
2. Donor Antennas
3. Coverage Antennas
4. Coaxial Cable and Coax Connectors
5. Splitters, Combiners, and Couplers
6. Battery Backup Unit

C. Planning shall include:

1. Model projected antenna locations based upon floor plan layouts.
2. Survey building conditions for signal coverage as building walls are built to verify antenna locations.
3. Survey building conditions for signal coverage at building commissioning to verify there are no signal conflicts prior to building opening.
4. Survey building conditions for signal coverage six (6) months after building is operational to ensure that there are no signal conflicts as building medical equipment has come online.
5. All surveys are to be completed utilizing PCTel's Touch platform or equivalent.

D. PSN Approval: The Contractor shall only propose and deploy a DAS system capable of receiving approval of the PSN Authority Having Jurisdiction (AHJ).

E. Supervision and Monitoring:

1. Provide the following outputs for monitoring by the Fire Alarm System. Connect these outputs to the fire alarm system for trouble monitoring:
   a. Donor Antenna Malfunction
   b. Signal booster Failure
   c. Signal Booster Trouble.
   d. Loss of AC Power
   e. Failure of Charging Circuit
   f. 70% of Battery Depletion

F. Battery Backup: Provide a UPS capable of backing up the DAS system for a period of 24-hours.

G. Mount antenna in an aesthetically pleasing manner.

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H. Provide plenum rated cabling throughout the entire system.

I. Performance Requirements:

1. The PSN DAS shall comply with local AHJ's code & requirement.
2. The DAS shall deliver coverage of -95 dBm RSSI throughout 95% of all occupied building spaces and 99% in critical areas as defined in NFPA 72/1221 unless specified otherwise by the AHJ.

J. Related Requirements

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section
2. Division-7 Firestopping, apply to work of this section
3. Division-26 Basic Materials and Methods sections apply to work specified in this section
4. SECTION 27 1500 COMMUNICATIONS HORIZONTAL CABLING
5. 2018 IFC SECTION 510
6. 2019 NFPA 1221

1.4 DEFINITIONS

A. AHJ: Authority Having Jurisdiction
B. AWS: Advanced Wireless Service
C. BC: Band Carrier
D. BDA: Bi-Directional Amplifier
E. BOM: Bill of Material
F. BTS: Base Transceiver Station
G. CDMA: Code Division Multiple Access
H. CW: Continuous Wave
I. DAS: Distributed Antenna System
J. dB: decibel
K. dBc: decibel relative to Carrier
L. dBm: decibel relative to milliwatts
M. DL: Downlink
N. DTF: Distance-to-fault
O. ERRCS: Emergency Responders Radio Communication System
P. IFC: International Fire Code
Q. LMR: Land Mobile Radio
R. LTE: Long Term Evolution
S. MHz: Megahertz
T. MIMO: Multiple Input, Multiple Output
U. PCS: Personal Communications System
V. PIM: Passive intermodulation

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W. POI: Point of Interface

X. PSN: Public Safety Network

Y. RL: Return Loss

Z. RSRP: Reference Signal Received Power

AA. RSSI: Received Signal Strength Indicator

BB. SINR: Signal-to-Noise Ratio

CC. SISO: Single Input, Single Output

DD. SMF: Single-mode Fiber

EE. TRCES: Two-Way Radio Communications Enhancement System

FF. UL: Downlink

GG. UMTS: Uniform Mobile Telephone Service

HH. VSWR: Voltage Standing Wave Ratio

II. WCS: Wireless Communications Service

JJ. WSP: Wireless service provider

1.5 SUBMITTALS

A. Submittal Requirements

1. Certificates:

a. An FCC-issued general radio operator license (GROL) is required to be held by the contractor.

b. A certificate from the manufacturer of the equipment to be installed stating that the DAS installer is trained or certified on the equipment.

2. Test Equipment:

a. Submit certificates indicating that staff is certified on required test equipment including but not necessarily limited to:

1) Signal Generators if required
2) Spectrum Analyzers
3) PIM Testers if required
4) Scanner

b. Submit current calibration data for test equipment to be used.

3. Bid Assumptions:

a. Contractors shall state the assumed channel count for the PSN Frequency Bands identified above with submittal of bid response. Prior to installation, contractors shall confirm the channel count and frequencies with the AHJ and shall guarantee coverage for these channels per the criteria stated above.

B. Submittal Requirements Prior to Start of Construction:

1. Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer’s designated representative.

2. Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer’s designated representative.

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3. The contractor shall explain the method used to avoid downlink and uplink interference.
4. Contractor will submit properly scaled floor plans showing the location of system Components:
   a. Coordinate all antenna locations with the architect utilizing the reflected ceiling plan during the submittal process. All locations must be approved and may be changed during the submittal process to eliminate antenna in certain locations.
5. Final RF link budget
6. Detail Drawings for Donor Antenna and grounding.
7. RF propagation modeling (Heat maps)
8. Product Data Sheets for each type of equipment to be installed.
9. Maintenance Service Contract
10. Permit drawings as required by the AHJ.
11. Acquire permission to rebroadcast public safety signal from AHJ and provide documentation as proof.

C. Submittal Requirements at Close Out:

1. Drawings: Submit as-built drawings indicating:
   a. Donor antenna, grounding and lighting protection details
   b. Cable routing, splitters, couplers and coverage antenna locations
   c. Active component locations, layout and configuration
2. Test Reports:
   a. PSN: Submit Accepted ATP reports confirming the requirements have been meet.
3. Cable Test Reports: Submit cable test results for all cable segments. Testing shall include Return Loss (RL) and Distance to Fault (DTF).
4. Field Reports: Submit OTDR test results for all fiber runs.
5. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
6. Acceptance Certificate or Document from the AHJ
7. Register the system with the FCC and provide documentation as proof.
8. Warranty Documents:
   a. Submit for all manufactured components specified in this Section.
   b. Submit Contractor’s System Warranty.
   c. Submit Manufacturer’s Extended Warranty

1.6 GUARANTEE AND CERTIFICATE

A. Any item of material, apparatus, or equipment, furnished and installed, or construction by the Contractor showing defects in design, construction, quality or workmanship within two years from the date of final acceptance by the State shall be replaced by such new materials, apparatus or parts as may be found necessary to make such defective portion of the complete system conform to the true intent and meaning of the Specifications and Drawings. Contractor shall turn over all manufacturer’s warranties to include 10, 15, and 25-year warranty programs for example.

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1.7 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials (except as hereinafter noted), tools, equipment and appliances required to provide and install all Distributed Antenna System (DAS) Work, complete, as indicated on the drawings and as specified herein. The drawings note various sizes of equipment as determined for basis of design; the electrical work, however, shall be installed by qualified electrician to comply with the equipment manufacturer's installation requirements that are furnished by the successful supplier.

B. The work shall include but not necessarily be limited to the following:

1. Complete design and build of wireless communications infrastructure systems including: all RF and fiber vertical and horizontal cabling, connectors, splitters, couplers, antennas, fiber patch panels, fiber distribution panels and equipment racks; excluding: junction boxes, cable trays, weather heads, pull boxes and conduits required.

2. Connector testing of terminated fiber and coaxial cabling and all active electronic equipment furnished and installed. Tested per manufacturers specifications for the following: RF multi-band sweep showing VSWR or Return Loss (in dB), DTF (distance to fault) and OTDR of fiber cabling showing total optical loss and reflection at 1310 and 1550nm wavelengths. All high voltage electrical connections, provided by others, will be tested for proper grounding and AC sinusoidal waveform compliance.

1.8 QUALIFICATIONS

A. Contractor shall have a minimum of 5 years documented experience in DAS design and deployment of cellular distributed antenna systems and over the air public safety wireless networks in which the last 3 years' experience to be submitted for review. All installers shall be required to have at least 3 years' experience and have certification by product manufacturer to be installed. Contractor and installer shall be certified by manufacturer and submit certification. Contractor must also have an iBwave 3 certified individual on staff as well as a general radio operators license (GROL).

B. Key personnel assigned to the project shall each have minimum of (10) years of experience in completing systems equal to this scope, quality, type and complexity

C. ERRCS installer shall be qualified to install the system per IFC (2018) Section 510.5.2

D. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.

E. Bids submitted by non-approved installers will not be accepted.

F. PRE-APPROVED INSTALLERS:

1. Groove Technology Solutions

1) Jim Henderson

a) Phone: (801) 396-6630

b) Email: JimH@getgrooven.com

G. Bidders not pre-approved shall submit in writing the following for review at least (8) working days prior to bid:

1. List of qualifications including:

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1) Industries certifications including manufacturers.

2) Approved resale manufacturers.

2. Past and current projects within the last 5 years similar in scope and size.

3. (3) Different referrals from the owners of (3) different projects within the last 5 years.

PART 2 - SYSTEM REQUIREMENTS

2.1 FREQUENCY / BAND REQUIREMENTS

A. ERRCS shall support the following bands:

1. 700 MHz Band (Public Safety)
   a. BC14 DL: 758-775 MHz
   b. BC 14 UL: 788-805 MHz
2. 800 MHz
   a. DL: 851-862 MHz
   b. UL: 806-817 MHz
3. 700/800 MHz LMR with AT&T FirstNet

2.2 SYSTEM PERFORMANCE

A. ERRCS

1. Shall comply with IFC 510/NFPA1221.

2. Coverage Requirement

   A. DL DAQ shall be (3.0 DAQ) or greater throughout 95% of all areas.
   B. DL DAQ shall be (3.0 DAQ) or greater throughout 99% of all critical areas, such as egress routes and stairwells

2.3 DAS MANUFACTURERS:

A. A. Subject to compliance with requirements, provide products by one of the following:

1. Approved DAS Active Components

   1) ERRCS

      a. Nextivity (Basis of Design)
      b. Wilson
      c. Westell Technogies

2. Approved DAS Passive Component Manufacturers (Refer to Specification 27 1500)
   a. Single Mode Optical Cable
      i. General Cable
      ii. Panduit
   b. CAT-6A Cable
      i. General Cable
      ii. Panduit
   c. Coaxial Cable
      i. Commscope

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ii. RFS

d. Couplers/Splitters/Diplexers

i. Commscope
ii. Waveform
iii. Wilson

e. Antennas

i. Commscope
ii. Laird
iii. Galtronics
iv. Nextivity

PART 3 - EXECUTION

3.1 FIBER OPTIC CABLING

A. Active distribution network requires single-mode fiber-optic cabling between system head end(s) and secondary distribution points.

B. Contractor to provide armored SMF backbone with twelve (12) strands to each expansion node location, terminated in a wall or rack mount fiber panel with LC angled polish (LC/APC) connector terminations.

C. All strands of each run shall be terminated at each expansion node location. Strands shall be terminated using core alignment fusion splicing of factory-polished APC connectors.

D. Contractor to provide LC/APC to LC/UPC single-mode fiber-optic jumpers from fiber panel to DAS equipment.

E. Contractor to provide innerduct or comparable protection for non-armored fiber-optic jumpers.

F. EMT or GRC conduit will be installed where required in section 27 0528.

3.2 DATA AND COAXIAL CABLING

A. For the ERRCS, the passive distribution network also requires coaxial cable between access points and antenna locations.

B. Distribution network may require and/or CAT-6A between expansion nodes and antenna or wireless access point locations.

C. GRC conduit will be installed where runs could be subject to vehicular impact.

D. All cables shall be supported at a minimum separation interval not to exceed cable manufacturer’s specification or Section 27 1500, whichever is more stringent.

E. The use of shared communications/data cable raceways is permitted for DAS cabling.

F. All new concrete cores’ locations must be submitted to the Owner’s staff for approval prior to drilling.

G. GPR/XRAY must be used to avoid damage where required in section 27 0528.

3.3 SYSTEM COMPONENTS

A. Active and passive components shall be installed in accordance with the system design and with Manufacturer’s recommended installation guidelines.

B. All active and passive components shall be labeled with machine generated labels.

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3.4 COMPONENT TESTING

A. Fiber-optic cabling

1. SMF shall be tested in accordance with Section 27 1500 for each strand of SMF.
2. All test results will be submitted for review.

B. CAT-6A cabling (if used)

1. All CAT-6A cabling shall be tested in accordance with Section 27 1500 and ANSI/TIA-568-C.2 standards.
2. All test results will be submitted for review.

C. Coaxial cabling

1. All field terminated coaxial cables shall be Sweep tested.
2. Return Loss (RL) testing, per segment of coax, for both low and high bands.
3. Distance to Fault/Return Loss (DTF) testing, per segment of coax, for both low and high bands.
4. Coax Sweep Testing Minimum requirements
   a. Low Band sweeps will be set at 698-960 MHz
   b. High Band sweeps will be set at 1710-2700 MHz
   c. All tests shall be into a calibrated load terminator.
   d. RL on any segment shall not exceed -18 dB
   e. DTF/RL shall not exceed -24 dB

D. Non-conforming work as covered in the General Conditions applies, but is not

E. limited to the following:

1. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced at no additional cost to the Owner.
2. Any defect in cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced to ensure 100% useable conductors in all cables installed at no additional cost to the Owner.
3. Correct deviation and repeat applicable testing at no additional cost to the Owner.
4. Re-test cable(s) and provide new test data.

F. CONTRACTOR TEST EQUIPMENT

1. The contractor shall ensure all contractor supplied test equipment is properly calibrated, and certified. If requested by the Owner, the contractor shall be able to supply any certificates tied to the quality and calibration of the test equipment.

3.5 Locate equipment, antennas and splitters at locations shown on the contract drawings:

A. Extend cabling from the EOS enclosures to the splitters in a neat and orderly manner per the routing indicated on the contract drawings. Support cabling in compliance with NEC chapter 8 requirements and manufacturers recommendations.

B. Maintain a 6” minimum distance from the DAS cabling and other cabling for parallel runs. Do not install coaxial cabling open in any areas were the cabling will be subject to physical damage.

C. All locations must be approved prior to installation via the submittal process. When providing the layout of the antennae, locate antennae in back of house spaces whenever possible.

3.6 EQUIPMENT MOUNTING:

A. Install wall mounted enclosures in telecommunication rooms in accordance with manufacturers instructions and seismic requirements.

B. Provide and install equipment rack in main telecommunications room. Fasten to the floor per manufacturers instructions and provide seismic bracing.

C. Install donor antennas per details shown on the contract documents.

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3.7 COORDINATION WITH OTHER TRADES:

A. Field coordinate the installation of the ERRCS headend equipment and remotes to ensure that each location is provided with the following:

1. A dedicated 120V, 20A emergency circuit for UPS equipment served from the life safety generator system.
2. (12) strands of single mode fiber from the head end location to each remote location terminated in LC/APC connectors.
3. Grounding per NEC and TIA standards.
4. Coordinate Alarm and Monitoring points with the Fire Alarm contractor.

3.8 EXAMINATION:

A. The contractor must examine areas and conditions under which ERRCS components are to be installed and notify the owner's representative, in writing of those conditions which are, in the Contractor's opinion, potentially detrimental to proper completion of the work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the owner.

B. Examine pathway elements intended for cable, check raceways, cable trays and other elements for compliance with space allocations, installations tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Specific items of examination shall include, but shall not necessarily be limited to, the following:
   a. Locations for all new ERRCS antennas, cable and splitter equipment.
   b. The Contractor shall examine all rooms designated to house ERRCS equipment to ensure adequate space, power, and environment conditions to support installation.

3.9 COMMISSIONING:

A. DAS commissioning will occur when head end DAS components are integrated and configured.

B. Contractor shall submit a system commissioning and testing plan to the Owner prior to commissioning.

C. Contractor shall submit certificate from the manufacturer of the equipment installed stating that the DAS installer is trained / qualified on the equipment.

3.10 WARRANTY:

A. Splitters, Couplers, and Coverage Antennas: 5-year limited warranty from date of completion.

B. Coaxial Cable and Connectors: 10 -year limited warranty from date of completion.

C. Fiber-Optic Cable: 20-year limited warranty from date of system completion.

D. Active Components: The earliest of 1-year limited warranty from date of completion.

END OF SECTION 27 5320

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SECTION 28 0501

COMMON REQUIREMENTS FOR ACCESS CONTROL AND IP VIDEO SURVEILLANCE SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Architectural, Structural, Mechanical, Electrical and other applicable documents are considered a part of the security documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the security set is not acceptable.

C. Division 26, 27 & 28 basic materials and methods sections apply to work specified in this section, including but not limited to for requirements for raceways, trays, boxes, and fittings, and supporting devices, and other sections, as applicable.

D. Refer to specification 26 0553 Electrical Identification for cabling, conduit, and junction box color requirements.

E. Refer to specification 27 1500 Telephone Data Systems for the specified category cabling and optical fiber cabling, connectivity specifications, additional pathway requirements, and installation standards.

F. This specification does not address other Division 28 sections, such as the Nurse Call System and/or Fire Alarm and Detection Systems.

1.2 ENGINEER CONTACT INFORMATION:

A. BNA Security Consultant Contact:

1. Dan Varney
   Phone: 801-532-2196
   Email: DVarney@BNAConsulting.com

1.3 DESCRIPTION OF WORK:

A. Security work is defined as any Division 28 system specified, including but not limited to access control, intrusion detection, and/or video surveillance systems.

B. The extent of security work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision, and service necessary for complete and working systems.

C. Provide the specified systems in a complete and operating condition with all necessary materials and labor to fulfill the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components. Contractor shall provide all cables, materials, and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

D. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports, and plenum space requirements. Contractor shall provide plenum rated cabling if required per the mechanical drawings.

E. The contractor shall provide ¾" EMT conduit from devices to accessible ceiling space, then utilize non-continuous cable support devices to the head-end equipment, utilizing cable tray if on project.

F. All security systems installed shall allow seamless integration and operate with one another (Access Control – IP Video Surveillance).

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G. All raceways and enclosures shall be securely fastened and/or mounted as per the currently adopted version of the National Electrical Code (NFPA 70). All work must be completed in a neat and workmanlike manner.

1.4 BID SUBMITTAL:

A. Provide a detailed scope of work document for all services provided.

B. Provide a complete bill of materials for all components, accessories, and hardware to be provided to assemble a complete and working system as described within the contract documents.

C. Provide a breakout cost of material and labor as different line items. Bids must include line-item pricing for major parts and components of the system.

D. Submit manufacturer certifications for all systems provided. Certifications must be from the local office providing the installation.

E. All permitting costs shall be included in base bid.

F. All equipment shall be installed as shown on the drawings and in strict accordance with the specifications. Any errors, conflicts, or omissions discovered in the specifications, or drawings, shall be submitted in writing to the Security Consultant for clarification in an RFI prior to bid.

1.5 QUALITY ASSURANCE:

A. MANUFACTURERS: Firms regularly engaged in manufacture of security system equipment and components of the types described here in and whose products have been in satisfactory use in similar applications for not less than five years.

B. Integrating firm shall have worked satisfactorily for a minimum of five years of completing systems equal to this scope, quality, type, and complexity.

1. Key personnel assigned to the project shall each have a minimum of five years of experience in completing systems equal to this scope, quality, type, and complexity.
2. Contractor shall be a factory authorized installer of all equipment specified for the geographical area of the project.
3. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
4. The installation contractors shall have current manufacturer certifications for all security systems and equipment listed within this specification. Certifications must be from ***local*** office providing the installation.

C. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.

D. All technicians are required to have proper state licensing to perform work within this specification.

E. List of qualifications include:

1. Industries certifications including manufacturers.
2. Past and current projects within the last five years are similar in scope and size.
3. Provide three different referrals from the owners of three different projects within the last five years.

1.6 GENERAL COORDINATION:

A. Meet with Electrical Contractor prior to pathway rough-in to coordinate system requirements in each area and review each security device that requires 120V power.

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B. Meet with Owner's IT Department prior to ordering equipment to coordinate IT services to equipment.

C. Meet with Low Voltage Cabling Contractor (Division 27 1500) at least once, prior to rough-in, to verify all category cabling needs to equipment.

D. Regular inspections are required and shall be scheduled by the contractor through the Owner/Architect at least twenty-four hours in advance.

E. Coordinate color and finish of all components with Architect.

F. Notify engineer of any modifications between contract documents and submittals. It is the contractor's responsibility to ensure compliance with the documents.

G. Contractor's Project Manager will be required to schedule and provide weekly updates via remote meeting and/or email communications on progress of installation and update project schedule if any dates change from original completion.

1.7 SUBMITTALS:

A. Refer to specification 26 0502 "Electrical Submittals and Spare Parts" for submittal requirements.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide complete raceway system for security system including but not limited to, raceway, outlets, cover plates, backboards, cabinets, grounding and miscellaneous items as required.

B. Provide plywood terminal backboards, 4' x 8' x ¾" unless otherwise noted for all security equipment unless otherwise noted to be installed in racks.

PART 3 – EXECUTION:

3.1 GENERAL REQUIREMENTS

A. Provide and install proper finger wire duct with covers within each panel per project requirements. Provide and install Velcro to neatly bundle cables. All cabling shall be installed in a neat and workmanlike manner.

B. Install systems as indicated, in accordance with equipment manufacturers' written instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with NEC requirements and applicable portions of NECA's "Standards of Installation" practices.

C. Coordinate all equipment locations and mounting details with other trades and suppliers.

D. Provide at least one duplex receptacle on dedicated power circuit next to specified panels.

E. Grounding: Provide grounding connections sufficiently tight to assure permanent and effective ground.

F. Conceal raceways and conduits unless otherwise noted in specifications and drawings. Where exposed raceways are permitted, run parallel/perpendicular to walls.

PART 4 – TESTING:

4.1 GENERAL REQUIREMENTS:

A. Testing: Upon completion of installation of system and after energized, demonstrate system compliance with intent.

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B. Coordinate final inspection of the systems installed, with security consultant, three weeks in advance.

PART 5 – LABELING & TRAINING

5.1 GENERAL REQUIREMENTS:

A. The contractor shall develop and submit for approval a labeling system for the device and cable installation. Coordinate with the owner and negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels, and wall plates. The labeling system shall designate the cables' origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

B. All labels shall meet UL 969 requirements for legibility, defacement, and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size, and color.

5.2 TRAINING:

A. Provide four sessions that consist of two hours each of training on the operation of each system, at the job site, and at no cost to owner. Each system shall be fully functional and have been tested by the installation contractors prior to doing any training.

B. The installation contractors will terminate, program and test all of the equipment and devices. As built drawing package (refer to specification 26 0502 "Electrical Submittals and Spare Parts" for as-built drawing package requirements) shall be provided to the owner personnel before any training or commissioning shall begin. System loops will be tested, and any fault conditions found shall be corrected immediately by the contractor.

5.3 CYBERSECURITY

A. Contractor shall change all default username and passwords for all network devices provided. A Strong Password should -

1. Be at least 8 characters in length.
2. Contain both upper and lowercase alphabetic characters (e.g., A-Z, a-z)
3. Have at least one numerical character (e.g., 0-9)
4. Have at least one special character (e.g., ~! @#$%^&*()_-+=)

B. No written username or passwords shall be located in any areas of installation, except in the O&M manual.

C. Network devices to be set up on a separate network other than owner's LAN ensuring no internal or external users can access system without authorization. Follow manufacturers hardening guide and use best industry practices to secure network and devices provided by contractor and associated with system.

5.4 WARRANTY AND SERVICE:

A. The minimum warranty period shall be one year, the warranty period will begin when the system completion documents are submitted to the owners and the system has successfully passed all tests and inspections. Included in the completion documents will be a warranty and service contact form, this form will be filled out by the burglar alarm contractor, all necessary contact information shall be included to guarantee a response to the system site within 24 HOURS OF THE REQUEST FOR SYSTEM SERVICE. Only qualified technicians capable of making needed repairs and/or system programming are accepted to respond for service.

B. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

C. During warranty time period:

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1. Systems designed for 24/7 operation shall be repaired and/or replaced within 24 hours of time of notification. If defective components cannot be repaired in time, provide temporary equipment as required.
2. During warranty time period, upon owner request, the contractor shall provide programming changes up to (4) four times or 4 hours free of charge.

END OF SECTION 28 0501

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SECTION 28 2205

ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Refer to Division 8 for the door hardware schedule and requirements.

C. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

D. Division 28 0501 Common Work Results for Electronic Safety & Security, apply to this section.

1.2 DESCRIPTION OF WORK:

A. Provide a complete and operating access control system as indicated in the drawings and specifications, and is hereby defined to include, but not be limited to: access control server, control panels, reader boards, power supplies, visitor management system, credential card readers, badge printers, credentials/cards, raceway, outlets, cover plates, jacks, backboards, cabinets, grounding, video surveillance integration, intrusion detection integration, intercom integration, protective enclosures, and all required cable/wiring. Contractor shall furnish all cables, materials, and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.

B. Provide all necessary materials and labor to fulfill all the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components.

C. Contractor is responsible for coordinating with the Division 8 door hardware contractor to review the door hardware specification and ensure all components requiring a connection are installed.

D. Program the access control system that upon activation of an emergency lockdown, or preventative lockdown, a command from the administrative console, web browser, or app a communication protocol will be sent for all, or partial controlled doors, to be locked / unlocked.

E. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings for system intent. Provide a complete and functional system as described within the construction documents.

1.3 COORDINATION (ACCESS CONTROL SPECIFIC):

A. Coordinate with the owner, the Division 8 contractor, and the Division 26 contractor prior to rough-in to coordinate exact location and rough-in of end devices and door functionality. Carefully review Division 8 package (including door hardware schedule and specification) prior to bid and include all components requiring a connection by Division 26/28. Meet with Division 8 post-bid and prior to purchase of any equipment. It is not the Security Engineer's responsibility to complete the coordination between Division 8 and Division 26/28 for exact locations, connections, and rough-in.

B. All door hardware specified shall be reviewed upon award of the bid and before ordering any equipment.

C. During construction, each location showing equipment shall be walked by the contractor

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and any discrepancies on door hardware fit, finish, and function shall be brought to the architect and security engineer's attention immediately. It is the contractor's responsibility to provide a complete and functioning system and door opening.

D. Division 26, 27, and 28 contractors shall verify electrical service provided prior to ordering any electrical equipment serving electronic door hardware equipment and has the final responsibility for properly coordinating the electrical work, including the exact location of the electrical connection(s).

E. Obtain submittals of all door hardware equipment from door hardware specification and Division 8 and 28 contractors. Carefully review door hardware submittal and advise in writing of any discrepancies.

F. The contractor shall include necessary wiring and programming for fire-alarm panel tie-in and door release. The contractor is responsible for scheduling and coordinating with the fire alarm contractor. And it is the responsibility of the contractor to review the Division 8 package (specifications and door hardware schedule) to confirm which doors require fire alarm release.

G. Coordinate all interfaces between door hardware and electrical contractor, including any additional panel interface modules and licensing to provide interface between PoE/wireless electronic locks.

H. Provide a dedicated 20-amp circuit for access control panel equipment.

1.4 QUALITY ASSURANCE:

A. Pre-Approved, Manufacture Certified, and State Licensed Installation Contractors:

1. Utah Yamas
2. Stone Security
3. AVTEC

B. Bidders not pre-approved:

1. See Division 28 0501 Part 1.5.

PART 2 – PRODUCTS

2.1 GENERAL REQUIRMENTS:

A. Provide a complete and operable S2 NetBox access control system that meets the owners policies and requirements, operates to the manufacturer specifications and instructions, and maintains building security.

B. The network appliance shall be able to run on an existing TCP/IP network and accessible, configurable, and manageable from any network-connected PC with a browser and/or client.

2.2 AUTHORIZED ACCESS CONTROL EQUIPMENT MANUFACTURE:

A. LenelS2

1. S2 NetBox Access Control System

2.3 GENERAL EQUIPMENT REQUIREMENTS:

A. Provide all of the necessary equipment as a baseline to ensure a complete and a fully functional access control system is achieved:

1. Access Control Head-End Equipment, Control Boards, Power Supplies, Batteries, Etc.

Description	Manufacturer	Part Number

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Access Control Server		Per manufacturer
Access Control Operating Software	LenelS2	NetBox Enterprise Operating Software
Network Node Intelligent Field Panel	LenelS2	S2-NN-E2R-WM
Access Control Application Blade	LenelS2	S2-ACM
Supervised Input Application Blade	LenelS2	S2-INP
Relayed Output Application Blade	LenelS2	S2-OUTP
Flexible Network-Connected Door I/O Module	LenelS2	LNL-1324e
Electrified Door Hardware Power Supplies	LifeSafety Power. Altronix	
Rechargeable Back-Up Battery	Yuasa, PowerSonic UltraTech, Interstate	12VDC 8Ah

2. End Devices

OSDP Credential Card Reader-Wall Mount	SCHLAGE	MTB15
OSDP Credential Card Reader-Mullion Mount	SCHLAGE	MTB11
STI Universal Stopper Cover for Card Reader	STI	STI-1 _ _ _ _
12V Red LED Indicator Light on a Single Gang Faceplate		Open
Mifare DESFire EV3 Credential Cards	SCHLAGE	8943 (Quantity 100)
Request-To-Exit Motion	Bosch, Kantech	DS160, T.Rex-XL
Request-To-Exit Motion Trim Plate	Bosch, Kantech	TS160, T.Rex-Plate
Push-To-Exit Button	Securitron	EEB (or equivalent)
Recessed Door Position Contact	Bosch	ISN-CSD70 (or equivalent)
Track Mount Garage Door Position Contact	Bosch	ISN-C66 (or equivalent)
Roof Hatch Position Contact	Bosch	ISN-CMET-200AR
Momentary Door Release Button	Alarm Controls, RCI	TS-18, 909
Duress / Panic Button	Honeywell, Amseco	269R, HUSD-15BL/BM
IP Two-Way Audio Video Intercom System		
“2N IP Verso 2.0” Door Station	2N	#02908-001
128GB Micro SDXC Memory Card	AXIS	#5801-951
“Indoor View” Answering Base Station	2N	#02087-001 (BLK)
Answering Base Station Desk Stand	2N	#02039-001 (BLK)

B. Equipment lists are provided to set equipment expectations and may not be complete. Coordinate with devices shown on drawings, system risers and equipment list for system intent. Provide a complete and functional system as described within the construction documents.

1. DIV.28 to provide all integrated credential card readers/electrified lockset combinations.
2. DIV.28 shall provide all the power supplies and rechargeable back-up batteries for the electrified door hardware equipment. Coordinate with the DIV.8 for the exact power requirements.
3. DIV.8 shall coordinate with the DIV.28, DIV.26, owner, and the architect for the door hardware that is going to be provided and getting installed.
4. DIV.28 to provide all of the door position contacts, request-to-exit motions, push-to-exit buttons, duress/panic buttons, momentary door release buttons, and the IP intercom system that tie into and operate with the access control system.
5. Provide 1 year of software updates for access control software.

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2.4 POWER SUPPLIES:

A. The DC voltage power supply shall have dual fused output ports, providing either 12VDC or 24VDC. It shall be powered by a 120VAC input. The system shall be expandable by adding up to three power modules, with each module offering power capacities ranging from 75W to 250W.

B. The system shall provide configurations for power distribution, control & signaling, fire alarm interface, fail safe/fail secure locking control, and shall be a standard feature of the system.

C. Locate separate or individual power supplies by the access control panels. Provide additional enclosures if needed.

D. Provide all access control panels and electrified door hardware power supplies with 12V sealed lead rechargeable backup batteries that will provide minimum standby power capacity for 24 hours.

E. Provide a category cable as required to each device for remote functionality such as control, status reporting, information logging, remote battery testing, fault reporting / restore, and shall interface with multiple control and monitoring modules to extend the remote functionality to multiple individual outputs for direct control, extended information gathering and reporting.

F. It is the Division 28 contractor's responsibility to provide power supplies for all electric locks, access control panels, and any other access control devices, to provide a complete & functional ACS system.

2.5 CREDENTIAL CARD READERS:

A. Connect contactless smart card reader with pigtail cable.

B. All credential card readers shall operate using OSDP (Open Supervised Device Protocol) to provide enhanced security, encryption, and monitoring capabilities..

C. Tamper detection on card readers shall be programmed to send notification through access control system in the event of damage or tampering.

D. The credential card reader must support and operate with mobile phone credentials.

E. Wall-mounted credential card readers are to be mounted on a four-square junction backbox with a single gang mud ring.

F. Mullion-style credential card readers mounted on mullions or door frames do not require a junction backbox. Route all cabling internally through the door frame or mullions to ensure a clean, secure installation.

G. Exposed cabling or conduit is not permitted.

PART 3 – EXECUTION

3.1 INSTALLATION OF THE ACCESS CONTROL SYSTEM:

A. GENERAL: Install the access control system as indicated, in accordance with the equipment manufacturer's specifications, written instructions, and with recognized industry practices, to ensure that system equipment complies with requirements.

B. Comply with applicable portions of the NEC regarding the types of products that are being used and installed. And to the NECA's "Standards of Installation" recognized industry practices, to ensure that system components are installed correctly and safely.

C. Prior to starting any work, coordinate and verify the access control layout, wiring, equipment device locations, and mounting details with the owner, architect, and any other trades and suppliers that are applicable, and get written approval.

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D. COORDINATION MEETINGS:

1. Meet at least twice with the door hardware systems installer. Hold the first meeting before the submittal of shop drawings to coordinate electronic door hardware components for each door, rough-in requirements, and door schedules. Hold the second meeting before the physical installation of components to verify raceway and cabling, equipment list, any changes have been accounted for, and site conditions for each area.
2. Review and coordinate access control system layout and wiring with owner.

E. NETWORK DEVICES: Provide network cable(s) to any networked devices for access control system and coordinate terminations.

F. Grounding: Provide grounding connections sufficiently tight to assure permanent and effective ground.

G. Testing: Upon completion of installation of system and after energized, demonstrate system compliance with intent.

H. WIRING & TERMINATIONS: All components of this system will need to be in accordance with the manufacture's specifications & recommendations. All final connections shall be made by a qualified & certified technician familiar with the manufacture's equipment and adhering to the owner's procedures.

I. ON-SITE EQUIPMENT: The contractor shall provide their own installation equipment unless they have written permission from the owner to use any of the owner's equipment (lifts, ladders, tools, etc.) onsite. It is the contractor's responsibility to provide all labor and equipment costs in their proposals.

J. ZONING: Each detector, door position switch, and sensing device shall be considered a location. Multiple doors at a common entry can be considered one location. The system shall be programmed to log and detect individual status of a monitored door based on a schedule. Doors with a door contact must have the ability to receive alerts for that specific opening if the door is opened during a certain time and/or left open for a specific time (60 seconds).

K. LABELING: The contractor shall develop and submit for approval a labeling system for the cable installation. Coordinate with the owner and negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels, and wall plates. The labeling system shall designate the cable's origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

1. All labels shall meet UL 969 requirements for legibility, defacement, and adhesion requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size, and color.
2. Provide laminated plans (minimum size 11x17) of all Security Systems as-built plans (including riser diagrams) at each telecom room/panel location.

L. Occupancy Adjustments: When required within one year of date of substantial completion, provide on-site assistance in adjusting and reprogramming to suit actual occupied conditions. Provide 1 visit to the site for this purpose without additional cost.

M. Mounting Height: Credential card readers and intercoms should meet all ADA mounting requirements. Card readers shall be mounted 48" from the floor to the top of the card reader.

N. Roof Access Hatch/Door: Verify each roof access hatch/door location with the owner and install a door position contact on each one. Each roof hatch door position contact shall be tied into the access control system, and into the intrusion detection system that will provide a scheduled notification when opened.

O. Request to Exit Motions: Prior to installation coordinate with the owner the location of the

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request to exit motions above the door.

P. Provide all relays required to tie access control system into fire alarm system.

Q. ADA Operation: Prior to starting any work, the installation contractor must coordinate with the owner, as well as the Division 8 and Division 26 contractors, and discuss how the access control equipment will need to integrate with the ADA equipment.

R. ADA Door Operator Requirements: Configure and program the access control and ADA equipment to operate in compliance with International Building Code (IBC) standards. Provide and install all necessary cabling, relays, and other components required to integrate the access control system with the ADA equipment, ensuring a seamless operation. The system must be programmed to meet the owner's specifications, including disabling the ADA equipment during lockout and closure periods to maintain security..

3.2 WIRING:

A. Pathway Requirements:

1. See specification 28 0501 for requirements.

B. Cabling:

1. See specification 27-1500 for category cable requirements.
2. All access control cabling must have a yellow outer jacketing, be UL Listed, stranded, and CMP rated.
3. Access Control OSDP Composite Cable:
   a. Windy City Wire: UL Listed, Overall White Jacket, Stranded, and CMP rated: #446100-OSDP-WCW.
4. Individual cables for access control end devices:
   a. Credential Card Readers:
      i. (1)- 22/1P OAS Lo-Cap, RS-485, 120 Ohms + 18-02 Twisted Non-Shielded,(OSDP) UL listed, White Jacketing, Stranded, and CMP rated.
   b. Request-To-Exit Motion:
      i. (1)- 22AWG 4-Conductor, UL listed, White Jacketing, Stranded, and CMP rated.
   c. Electrified Door Hardware Equipment:
      i. (1)- 18AWG 4-Conductor, UL listed, White Jacketing, Stranded, and CMP rated.
   d. Door Position Contact:
      i. (1)- 22AWG 2-Conductor, UL listed, White Jacketing, Stranded, and CMP rated.
   e. Push-to-Exit Button:
      i. (1)- 18AWG 4-Conductor, UL listed, White Jacketing, Stranded, and CMP rated.
   f. Panic/Duress Button and Momentary Door Release Button:
      i. (1)- 22AWG 4-Conductor, UL listed, White Jacketing, Stranded, and CMP rated.
5. Wiring by Divisions 26: The electrical connections/terminations for certain equipment provided under door hardware divisions has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the door hardware trade requiring such electrical connections. The Div.26 electrical contractor shall review the architectural drawings and the Div.8 Door Hardware specifications and coordinate with said contractors to confirm electrical needs.

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3.3 SYSTEM CONFIGURATION AND PROGRAMMING:

A. Configure and program the access control system for full functionality. Involve the owner as much as possible to ensure they understand the system's operation and facilitate a complete transfer of control.

B. Provide a fully functional access control system and ensure the entire system is operating as intended and in accordance with the owners policies and requirements.

C. Label cables on both ends in all boxes, panels, and racks according to the owners standards.

D. The contractor shall include in the base contract all costs required to program lockdown procedures based on the owners requirements and direction.

E. The contractor shall include necessary programming for fire-alarm panel tie-in and door release based upon the requirements and direction of the owner and/or AHJ.

F. Contractor shall input database of all required card holders and desired schedules for users and/or groups. It is the contractor’s responsibility to coordinate with the owner on which card holders have access to which openings.

END OF SECTION 28 2205

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SECTION 28 2300

IP VIDEO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.

C. Division 28 0501 Common Work Results for Electronic Safety & Security, apply to this section.

1.2 DESCRIPTION OF WORK:

A. Provide a complete and operating IP video surveillance system as indicated in the drawings and plans and is hereby defined to include, but not be limited to: IP surveillance cameras, IP surveillance camera mounting hardware & equipment, IP surveillance camera micro SDXC memory cards, in-line surge protectors, network video recorder (NVR) server, video management system (VMS) operating software, IP surveillance camera IP licenses, IP surveillance camera and recording analytic software & licensing, rack mounted monitor keyboards & mouse, power supplies, category jacks/modules, RJ45 modular plugs, input plates/enclosures, PoE network switches, remote mobile client application, integration with the access control system and the IP two-way audio video intercom system, protective enclosures, and all wiring and cabling that is normally and reasonably required.

B. Refer to the other Division 26 and 27 sections for requirements for raceways, trays, boxes and fittings, and supporting devices, category cabling, and other sections, as applicable.

C. The Div.27 contractor is to provide the following category cabling to IP surveillance cameras:

1. Interior (indoor) IP Surveillance Cameras: Provide one orange-jacketed CAT6 UTP, 4-pair, CMP rated category cable.

2. Exterior (outdoor) IP Surveillance Cameras: Provide one orange-jacketed CAT6 UTP, 4-pair, CMP rated category cable. Coil the category cable service loops inside the building.

3. Provide each CAT6 category cable with industry-standard service loops at both ends.

4. Homerun all CAT6 cables from the IP surveillance cameras to the designated telecommunications equipment rack. Terminate each cable at the assigned patch panel and perform testing to ensure proper functionality..

D. Provide the following equipment at the IP surveillance camera locations:

1. Terminate one CAT6 jack to the CAT6 category cable and install it into a single surface mount box inside the camera junction backbox.

2. Provide one orange CAT6 patch cable that goes from the CAT6 jack to the IP surveillance camera.

E. The specified CAT6 category cabling for the IP video surveillance cameras and recording system will be provided by the Division 27 low voltage cabling contractor, ensuring a

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single installer and unified cable warranty.

F. The school district will provide and install the Network Video Recorder (NVR), Video Management System (VMS) software, and PoE switches. All other equipment, including IP surveillance cameras and mounts, IP surveillance camera licenses, SDXC micro memory cards, in-line category surge protectors, monitors, and any additional items required for a complete and fully functional IP video surveillance system, shall be provided and installed by the Division 28 IP video surveillance system installation contractor.

G. The Division 26 electrical contractor shall coordinate with the owner and the Division 28 video surveillance contractor before starting any rough-in or work and review all IP video surveillance equipment locations and there rough-in requirements (e.g., surveillance camera locations, heights, and orientations; manufacturer-recommended junction backbox sizes; head-end NVR location, etc.).

H. Contractors shall provide all labor, materials, tools, and equipment required for the complete installation of work.

1.3 COORDINATION:

A. The contractor shall coordinate the color and finish of all camera components with the architect or electrical contractor, as appropriate. Black camera finishes shall be provided for all cameras installed in locations with dark surroundings, whether wall-mounted or ceiling-mounted.

1.4 QUALITY ASSURANCE:

A. Comply with the applicable portions of these codes and standards :

1. NDAA (National Defense Authorization Act).
2. NEC (National Electrical Code).
3. NECA (National Electrical Contractors Association).
4. ANSI/BICSI (American National Standards Institute / Building Industry Consulting Services International).
5. ANSI/TIA (American National Standards Institute / Telecommunications Industry Association).
6. ANSI/EIA (American National Standards Institute / Electronic Industries Alliance).

B. Provide products and materials that have been UL-Listed and labeled.

1.5 APPROVED INSTALLATION CONTRACTORS:

A. Pre-Approved, Manufacture Certified, and State Licensed Installation Contractors:

1. Utah Yamas
2. Stone Security
3. AVTEC

B. Bidders that are not pre-approved:

1. Refer to Division 28 0501 Part 1.5.B.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS:

A. The network appliance shall operate on the existing TCP/IP network and must be accessible, configurable, and manageable from any network-connected PC using a

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browser and/or client software.

2.2 AUTHORIZED EQUIPMENT MANUFACTURE:

A. NDAA Compliant & ONVIF Compatible IP Surveillance Camera Manufacture(s):

1. AXIS Communications

2.3 IP SURVEILLANCE CAMERA REQUIREMENTS:

1. IP surveillance cameras shall be fully supported by the VMS manufacturer.
2. All IP surveillance cameras are denoted by subscript on plans and shall be PoE or PoE+.
3. IP surveillance cameras shall have the proper IP and IK ratings for the environments that they are getting installed into.
4. All exterior IP surveillance cameras regardless of their locations shall have enclosures that are IP66 & IK10 rated. These types of enclosures ensure protection against external elements and vandalism for the camera's internal operating components and wiring.
5. Exterior IP surveillance cameras may be domes or other environmental style housings which suit the general appearance of the facility.
6. All exterior and interior IP surveillance camera category transmission cables must be protected against lightning and other related power surges with in-line category/ethernet surge protectors.
7. Provide each IP surveillance camera with a minimum of one removable 128GB micro SDXC memory card for edge recording storage.
8. Coordinate all camera locations, wiring, and rough-in requirements with owner and supplier prior to rough-in.
9. The camera shall be equipped with one 100BASE-TX Fast Ethernet port or faster, using a standard RJ45 connector and shall support auto negotiation of network speed (100 Mbps and 10 Mbps) and transfer mode (full and half duplex)
10. Provide camera types and quantities as indicated on the associated drawings.

2.4 Network Equipment

A. Provide a short-depth, rack-mounted LCD monitor with an integrated keyboard and mouse drawer for use with the Network Video Recorder (NVR).

2.4 WIRING / CABLING, AND PATHWAYS:

A. See Specification 27 1500 Telephone Data Systems for cabling and 28 0500 for pathway requirements.

PART 3 – EXECUTION

3.1 INSTALLATION OF THE IP CAMERAS AND VIDEO SURVEILLANCE SYSTEM:

A. Before starting any work, conduct a walk-through with the owner and the Division 26 contractor to verify all device locations, then install the IP surveillance cameras at the locations indicated in the plan drawings.

B. Coordinate all cabling work, patch cabling and labeling with owner.

C. Contractor shall configure and program all of the IP cameras views, focus, frame rates, resolutions, and IP addressing.

D. Contractor shall be responsible for coordinating work with owner and the IT staff to coordinate devices on network specific to the video surveillance system.

E. Contractor shall verify all of the IP camera mounting locations, heights and the orientation of the camera to ensure the most ideal views for each camera are met. Typical mounting

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height to be 9-12’ unless noted in plans.

3.2 FIELD QUALITY CONTROL:

A. Testing: Upon completing the installation of the IP video surveillance system and energizing the electrical circuitry, test the system for compatibility and compliance with all requirements. Correct any malfunctioning units on-site whenever possible, then retest to confirm compliance. If issues cannot be resolved on-site, replace defective units with new ones and conduct retesting.

3.3 SYSTEM CONFIGURATION AND PROGRAMMING:

A. Configure and program the IP video surveillance system for full functionality. Involve the owner as much as possible to ensure they understand the system's operation and facilitate a complete transfer of control.

B. Provide a fully functional IP video surveillance system and ensure the entire system is operating as intended and in accordance with the owners policies and requirements.

C. Contractor is to program the system and train the authorized personnel how to perform all necessary functions of the video surveillance system. Refer to Division 28 0501 Common Work Results for Electronic Safety & Security Part 5.2.

END OF SECTION 28 2300

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SECTION 28 3111

FIRE DETECTION AND ALARM SYSTEM

ENGINEERING SPECIFICATION
INTELLIGENT REPORTING FIRE DETECTION SYSTEM

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

C. Section 13800 - Building Automation and Control.

D. Section 13900 (21 00 00) - Fire Suppression.

E. Section (27 15 00) - (Fire Alarm Communications Horizontal Cabling).

1.2 DESCRIPTION

A. Extent of fire alarm and detection systems work is indicated by drawings, schedules and as specified herein.

B. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems that are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories that are FM approved. Comply with State and local requirements as applicable.

C. Comply with applicable provisions of current NFPA Standards 72, National Fire Alarm Code, local building codes, and meet requirements of local authorities having jurisdiction. Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

D. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

1. Locate FACP Panel within the MDF/Equipment Room.

2. Provide additional transponders and power supply panels as needed throughout the project.

E. The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

F. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

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G. The fire alarm system shall be manufactured by an ISO 9001:2008 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994

H. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). It's acceptable for peripheral devices to be manufactured outside of the U.S. by a division of the U.S. based parent company.

I. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

J. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

K. Provide new duct smoke detectors and fan relays at all fan units 2000 CFM and over. Shut down al supply and return fans upon a general alarm signal.

L. Provide CO detectors, Monitor Module and fan relays at all gas fired fan units. Shut down all supply and return fans upon a general alarm signal.

M. Install all wiring in **RED-COLORED** steel conduit (3/4" minimum). All conduit runs shall form a complete loop from the fire alarm control panel.

N. Provide vandal resistant cages to protect horn/strobes, smoke and heat detectors as indicated on drawings and, in gyms whether shown or not. Securely fasten security cages as required. Provide backing and bracing as required to ensure that attachment extends beyond the ceiling materials. Cages shall have two pieces, one backplate and one cover to attach to backplate. Provide cages/guards on horn/strobes that are clear and do not limit their effect on the field performance with the listing requirements.

O. Comply with applicable provisions of current NFPA Standard 72 National Fire Alarm and Signaling Code (as applicable), local building codes, the most current adopted revision of the International Building Code (IBC), the International Fire Code (IFC), the International Mechanical Code (IMC), and meet requirements of local authorities having jurisdiction.

P. Carefully review all Division 23 drawings for all fire/smoke and smoke dampers. Fire/smoke and smoke dampers are NOT shown on electrical plans. Electrical contractor is responsible for coordinating 120V power to all dampers and providing fire alarm connections to each one. See mechanical drawings for all locations.

Q. Coordinate exact quantity and locations of all fire sprinkler system tamper and flow switches with fire sprinkler drawings. Provide and connect all tamper and flow switches to fire alarm system.

R. Provide a fire alarm duct detector within 5-feet of any fire/smoke damper as required to comply with IMC 607.5.4.1. The duct detector shall be listed for the air velocity, temperature and humidity at the point where it is to be installed. A duct detector will not be required at a fire/smoke damper located on a corridor wall where the corridor has smoke detection devices installed. For dampers installed within an un-ducted opening in a wall, a spot-type detector listed for releasing service shall be installed within 5-feet horizontally of the damper. Provide a fire alarm relay at each fire/smoke damper. Provide a test switch at each location where the damper is located above an inaccessible ceiling or is located more than 10 feet above the finished floor. Coordinate the location of test switches with owner/architect.

S.

1.2 SUBMITTALS: Refer to Section 26 0502 for requirements.

1.3 SCOPE

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A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings.

B. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
2. Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.
8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
   Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
   Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
   Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.
11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

    a. The digital amplifier shall automatically broadcast the stored audio message.
    b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
    c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
    d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.
    e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
    f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

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1.4 GUARANTY

A. The fire alarm control panel, voice panels, and any head-end equipment shall have a manufacturer's warranty of a minimum of 3 years.

1.5 POST CONTRACT MAINTENANCE

A. Complete maintenance and repair service for the fire detection system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materials, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

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1.6 APPLICABLE STANDARDS AND SPECIFICATIONS

A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

B. National Fire Protection Association (NFPA) - USA:

No. 12	Extinguishing Systems (low and high)
No. 12A	Halon 1301 Extinguishing Systems
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 16	Foam / Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
No. 2001	Clean Agent Extinguishing Systems
No. 70	National Electric Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas
No. 72	National Fire Alarm Code
No. 101	Life Safety Code

C. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 2572	Mass Notification Systems
No. 217	Smoke Detectors, Single and Multiple Station
No. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances

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No. 38	Manually Actuated Signaling Boxes
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2017	Standard for General-Purpose Signaling Devices and Systems
No.60950	Safety of Information Technology Equipment

D. Local and State Building Codes.

E. All requirements of the Authority Having Jurisdiction (AHJ).

1.7 APPROVALS

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories, Inc
ULC	Underwriters Laboratories Canada
FM	Factory Mutual
FM 6320	Factory Mutual Gas Detection System
USFM	Utah State Fire Marshal

B. The system shall be certified for seismic applications in accordance with the International Building Code (IBC). For OSHPD applications in California the system shall be Pre-Approved for seismic applications. The basis for qualification of seismic approval shall be via shake table testing.

C. The system shall be approved for Marine Applications and carry the following certifications:

1. USCG United States Coast Guard
2. Lloyd's Register
3. ABS American Bureau of Shipping

D. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

PART 2.0 PRODUCTS

2.1 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE

A. Main FACP or network node shall be a NOTIFIER Model NFS2-3030 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as

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conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

2.2 SYSTEM CAPACITY AND GENERAL OPERATION

A. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels / nodes per network.

B. The control panel shall be capable of expansion via up to 10 SLC loops. Each module shall support up to 318 analog/addressable devices for a maximum system capacity of 3180 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either company.

C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.

D. The FACP shall be able to provide the following software and hardware features:

1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
4. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.
5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.
8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.
10. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.
11. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke

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Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.
13. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.
14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions
15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.
16. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.
17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
18. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.
19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
21. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result of all cooperating detectors chamber readings.
22. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.
23. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
24. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
25. Security Monitor Points: The system shall provide means to monitor any point as a type security.
26. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to

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input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

27. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
28. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
29. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
30. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
31. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
32. Control-By-Time: A time-based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
33. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.
34. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

E. Network Communication

1. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

F. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

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2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
4. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
5. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
6. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

G. Display

1. The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
2. The system display shall provide a keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

H. Loop (Signaling Line Circuit) Control Module:

1. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159monitor or control modules.
2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
3. Each Loop shall be capable of operating as a NFPA Style 4 (Class B) circuit.
4. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

I. Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.
2. Function: The Voice Command Center equipment shall perform the following functions:

    a. Operate as a supervised multi-channel emergency voice communication system. Operate as a two-way emergency telephone system control center.
    b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
    c. Audibly and visually annunciate any trouble condition for digital tone and voice units

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required for normal operation of the system.

d. Provide all-call Emergency Paging activities through activation of a single control switch.
e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.
h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.
i. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

J. Power Supply:

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.
4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Main Power Supply shall be power-limited per UL864 requirements.
6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunciated and logged to the system alarm history log.
7. Addressable Charger Power Supply. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24 VDC power. . NOTIFIER model # ACPS-610
8. The addressable power supply for the fire detection system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10.0 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12 - 200 amp hour batteries.
9. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as Class "A" or Class "B" circuits. All circuits shall be power-limited per UL 864 requirements.
10. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
11. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
12. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use

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an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.

13. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
14. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
15. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
16. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
17. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
18. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
19. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
20. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
21. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
22. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power () for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:

    a. Earth Fault on DAP A (Digital Audio Port A)
    b. Earth Fault on DAP B (Digital Audio Port B)
    c. Audio Amplifier Failure Detected Trouble
    d. Active Alarm Bus input
    e. Audio Detected on Aux Input A
    f. Audio Detected on Aux Input B
    g. Audio Detected on Firefighter's Telephone Riser
    h. Receiving Audio from digital audio riser
    i. Short circuit on speaker circuit 1
    j. Short circuit on speaker circuit 2
    k. Short circuit on speaker circuit 3
    l. Short circuit on speaker circuit 4
    m. Data Transmitted on DAP A
    n. Data Received on DAP A
    o. Data Transmitted on DAP B
    p. Data Received on DAP B

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q. Board failure
r. Active fiber optic media connection on port A (fiber optic media applications)
s. Active fiber optic media connection on port B (fiber optic media applications)
t. Power supply Earth Fault
u. Power supply 5V present
v. Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble

4. The audio amplifier shall provide the following built-in controls:

   a. Amplifier Address Selection Switches
   b. Signal Silence of communication loss annunciation Reset
   c. Level adjustment for background music
   d. Enable/Disable for Earth Fault detection on DAP A
   e. Enable/Disable for Earth Fault detection on DAP A
   f. Switch for 2-wire/4-wire FFT riser

5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.
9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

L. Audio Message Generator (Prerecorded Voice)/Speaker Control:

1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
3. A built-in microphone shall be provided to allow paging through speaker circuits.
4. System paging from emergency telephone circuits shall be supported.
5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

   a. Lamp Test
   b. Trouble
   c. Off-Line Trouble
   d. Microphone Trouble
   e. Phone Trouble
   f. Busy/Wait
   g. Page Inhibited
   h. Pre/Post Announcement Tone

M. Controls with associated LED Indicators:

1. Speaker Switches/Indicators

   a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
   b. The speaker circuit control panel shall include switches to manually activate or deac-

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tivate each speaker circuit in the system.\

2. Emergency Two-Way Telephone Control Switches/Indicators

    a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
    b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

N. Remote Transmissions:

1. Provide local energy or polarity reversal or trip circuits as required.
2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

O. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
2. All field defined programs shall be stored in non-volatile memory.

P. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

Q. System Point Operations:

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

    a. Device Status.
    b. Device Type.
    c. Custom Device Label.
    d. Software Zone Label.
    e. Device Zone Assignments.
    f. Analog Detector Sensitivity.
    g. All Program Parameters.

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4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.3 SYSTEM COMPONENTS

A. Portable Emergency Telephone Handset Jack

1. Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.
2. Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.
3. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

B. Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled emergency telephone. The cabinets shall be located where shown on drawings.
2. The handset cradle shall have a switch connection such that lifting the handset off of the cradle shall send a signal to the fire command center which shall audibly and visually indicate its on-line (off-hook) condition.
3. The two-way emergency telephone system shall support a maximum of seven (7) handsets on line (off hook) without degradation of the signal.

C. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.
3. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.

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4. Communication shall include vital system status such as:

    a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
    b. Independent Addressable Device Status
    c. AC (Mains) Power Loss
    d. Low Battery and Earth Fault
    e. System Off Normal
    f. 12 and 24 Hour Test Signal
    g. Abnormal Test Signal (per UL requirements)
    h. EIA-485 Communications Failure
    i. Phone Line Failure

5. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
6. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.
7. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.
8. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

D. Field Wiring Terminal Blocks

1. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

E. Printer

1. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 120 VAC @ 60 Hz.
2. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.
3. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

F. Smoke Control Annunciator

1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC,

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and NFPA 92A & 92B, Smoke Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.
3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.
4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.
5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.4 GATEWAY & WEBSERVER OPTIONS

A. Common Alerting Protocol (CAP) Gateway: The system shall support an optional CAP Gateway (Common Alerting Protocol). The CAP Gateway translates fire system messages to industry standard CAP messages for integration with CAP-compliant clients. A CAP gateway shall be available from the fire alarm control panel manufacturer.

B. LEDSIGN Gateway: The system shall support an optional and proprietary LEDSIGN Gateway to interface to LED signs that will automatically display emergency messages. The signs shall be capable of storing up to 100 messages that can be activated via system programming with the ability to be manually overridden. The Sign Gateway shall support up to 10 independent signs, each sign capable of playing an independent message. Multiple LEDSIGN Gateways can be used in network applications. An LEDSIGN gateway shall be available from the fire alarm control panel manufacturer.

C. BACnet Interface Gateway: The system shall be capable of being interfaced with BACNet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer.

D. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer.

E. Noti-Fire-Net Gateway: The system shall support an IP based gateway to enable the panel or local Noti-Fire-Net to be connected to an ONYXWorks workstation via the Internet or Intranet. This gateway shall also support the ability to integrate the system to an interactive firefighter's display. The Noti-Fire-Net Gateway shall be available from the fire alarm control manufacturer.

F. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.

G. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

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2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.
2. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
3. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
4. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.
5. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
6. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
7. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
8. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
9. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.
10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL).
11. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
12. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
14. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data

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to the panel representing the state of the manual switch and the addressable communication module status;NOTIFIER model # NBG-12LX. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall be NOTIFIER model # FSP-951 and shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

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D. IntelliQuad™ PLUS Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector shall be NOTIFIER model # FCO-951 and shall be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.
2. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.
3. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.
4. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.
5. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.
6. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.
7. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.
8. The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.
9. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external

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remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.

10. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.
11. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

    a. 4.0" (10.16 cm) square box with and without plaster ring.
    b. 4.0" (10.16 cm) octagonal box.
    c. 3.5" (8.89 cm) octagonal box.
    d. Single-gang box.
    e. Double-gang box

12. Meets Agency Standards

    a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
    b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
    c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
    d. UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

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E. Intelligent Addressable Reflected Beam Detector

1. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a keyswitch; NOTIFIER model # FS-OSI-RI.

F. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs. The addressable monitor module shall be NOTIFIER model # FMM-1 (Class A or B)
2. The IDC zone shall be suitable for Style D/Class A or Style B/Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

G. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances; NOTIFIER model # FCM-1
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y;
3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.
4. For multiple circuit control a module shall be available that provides 6 Style Y (Class B) or 3

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Style Z (Class A) control circuits; NOTIFIER model # XP6-C.

H. **Addressable Relay Module:**

1. Addressable Relay Modules shall be available for HVAC control and other network building functions; NOTIFIER model # FRM-1.
2. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.
3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires;

I. Serially Connected Annunciator Requirements

1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. The repeater shall be UL864 approved.
3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.
4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.
5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
6. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

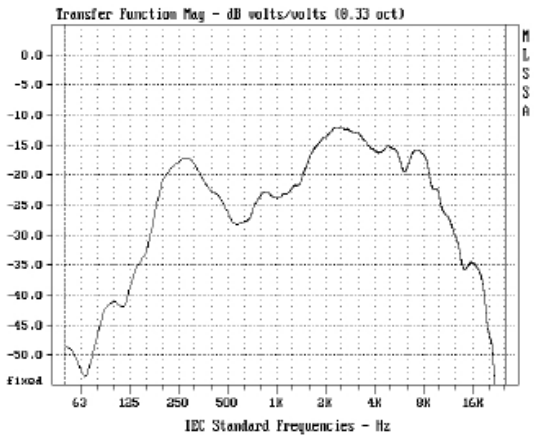
J. SpectrAlert Advance Speakers

1. The Speaker appliance shall be System Sensor SpectrAlert Advance model _____ Speaker. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
4. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
5. All notification appliances shall be backward compatible.

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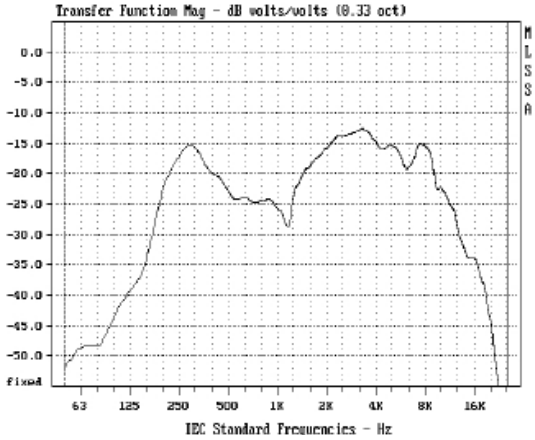
Ceiling Speaker

Wide Band Frequency Response



Wall Speaker

Wide Band Frequency Response



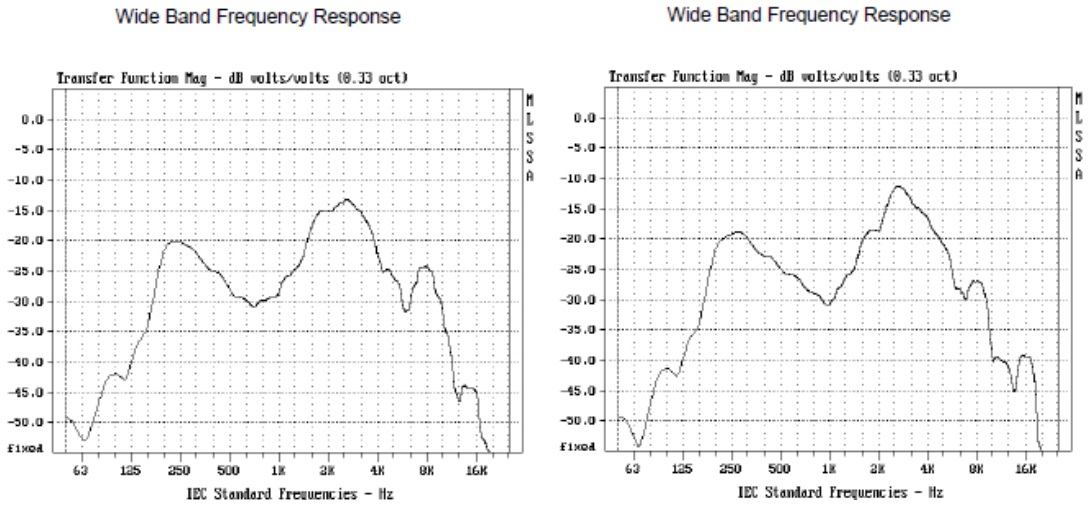
Note: The wide band frequency response is derived using MLS methods

K. SpectrAlert Advance Speaker Strobes

1. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance model _____ Speaker Strobe. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes and the Sync•Circuit™ Module MDL3 accessory, if used, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). When used with the Sync•Circuit Module MDL3, 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.
3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.
5. All notification appliances shall be backward compatible.

Ceiling Speaker Strobe **Wall Speaker Strobe**

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Note: The wide band frequency response is derived using MLS methods

6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971and be fully synchronized.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by CCSD and the major equipment manufacturer.

B. All conduit shall be **¾" Red in color**, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

E. Connection/Hookup Wire Color & Size for all shall be:

SLC Wire: Red 14/2, FPLP, Solid, Twisted, Unshielded
Strobes: Orange/Blue 14 AWG THHN
SYNC Wire: Pink/Purple #14 AWG Stranded
DAL Network: Belden 5320FL or 5320UM #18-2c BC
DAA2 to Speaker: 16-2C FPLR Riser
Soundier Base: Red/Black #14 AWG THHN Solid Copper
Door CKT: Red/Black #14 AWG THHN Solid Copper
FSD Shutdown: Red/Black #14 AWG THHN Solid Copper
Door Magnets: Red/Black #14 AWG THHN Solid Copper

3.2. TEST:

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The service of a competent, factory-trained engineer or technician authorized by the manufacturer and CCSD of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.

C. Verify activation of all waterflow switches.

D. Open initiating device circuits and verify that the trouble signal actuates.

E. Open and short signaling line circuits and verify that the trouble signal actuates.

F. Open and short notification appliance circuits and verify that trouble signal actuates.

G. Ground all circuits and verify response of trouble signals.

H. Check presence and audibility of tone at all alarm notification devices.

I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect to CCSD Master Tech.

3.4. INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

PART 4 - AS BUILT DRAWINGS AND OPERATION AND MAINTENANCE MANUALS:

4.1 LABELING:

A. All devices shall be labeled with their appropriate address. The labels shall be 18 point pressure sensitive labels.

B. All initiating devices shall be programmed to include the device address and a complete

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user text English location description, i.e. Device L4S76, Smoke Detector, 1st floor Rm.17

4.2 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

4.3 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

4.4 TRAINING:

A. Provide four (4) hours training on the operation and installation of fire alarm system, at job site, at no cost to owner. Provide programming training and software sub-licensing in owner's name. Sub-licensing agreement shall include the U.L. requirement to allow the owner to do any programming that the supplier is allowed to do during commissioning, testing, service and field additions or deletions to the fire alarm system. The fire alarm supplier shall provide this training and licensing at no cost to the owner, including transportation (if outside Salt Lake City), lodging, meals, and training manuals.

END OF SECTION 28 3111

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HYDE PARK ELEMENTARY ERCES

PRELIMINARY DESIGN- 700MHZ ERCES



Prepared By:

GROOVE
TECHNOLOGY SOLUTIONS

6849 S 700 W, Midvale, UT 84047

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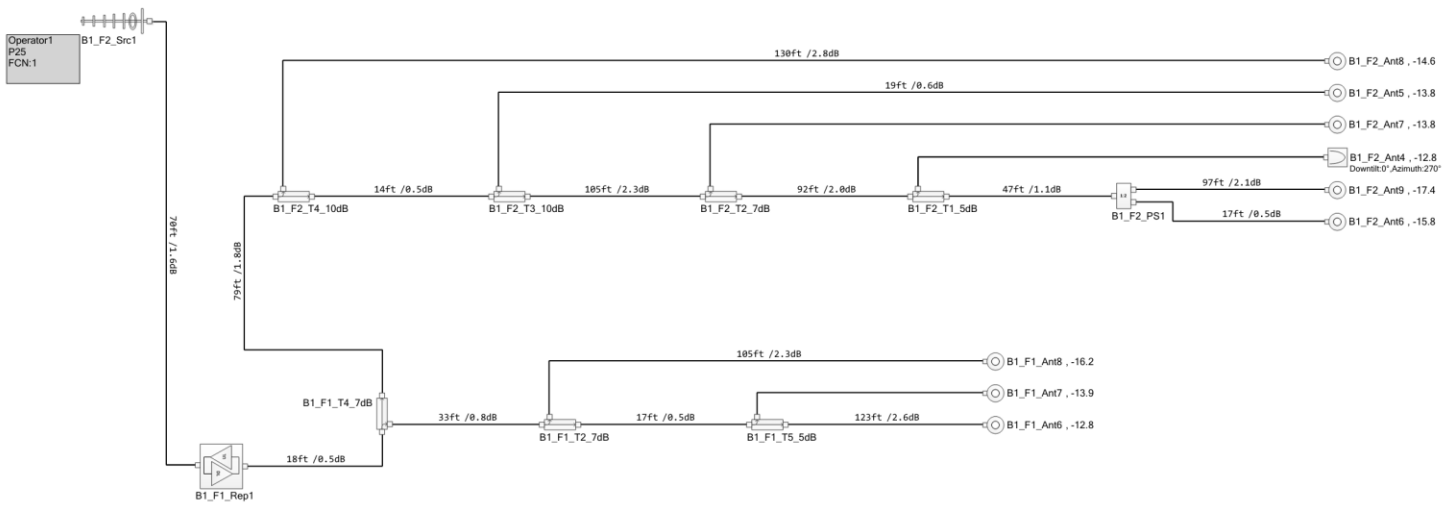
1.0 SCOPE OF WORK

Provide a turn-key 700MHz Class A public safety DAS solution for the Riverview Jr. High School rebuild. Integrator(s) must conduct their own due diligence in accordance with local building and fire codes as set forth by the local AHJ and FCC license holder(s).

1.1. APPROVED EQUIPMENT

DAS HEADEND- Nextivity SHEILD EXTEND 1W-6W Fiber DAS
COAXIAL CABLE- RFS PLENUM ICA12-50JPLLR
ANTENNAS- Nextivity Low Profile SISO
CONNECTORS- L4TNM-PSA/COMMSCOPE

1.2 NETWORK SYSTEM DIAGRAM



Device Legend	
Donor Site_3GPP	Directional Antenna
Omni Antenna	Coupler
2 PowerSplitter	Repeater

Plan Name	HYDE PARK NETWORK SYSTEM DESIGN		Date	03/23/2025	
Project Name	HYDE PARK ELEMENTARY ERCES 700/800MHz				
Designer Name	SH			Company Name	GROOVE TECHNOLOGY SOLUTIONS

1.3 ANTENNA LINK BUDGET REPORT

Antenna Link Budget Report

Project Name:	Hyde Park Elementary ERCES	**Design Company:**	Design Company
Project Creation Date:	3/24/2025	**Designer:**	Designer

Antenna ID	System ID	Antenna Gain (dBi)	System Pilot (dBm)	System Total (dBm)	Antenna Pilot (dBm)	Antenna Power Per Channel (dBm)	Coupler				
							Tap Loss				
							Generic				
							T-05-NF				T-07-NF
							4.999999(dB)		5(dB)		999999(dB
							Quantity	Subtotal(dB)	Quantity	Subtotal(dB)	Quantity
B1_F1_Ant6	B1_F2_Src1_YIVXCQSW	3		-85		-12.8					
B1_F1_Ant7	B1_F2_Src1_YIVXCQSW	3		-85		-13.9			1	5	
B1_F1_Ant8	B1_F2_Src1_YIVXCQSW	3		-85		-16.2					1
B1_F2_Ant4	B1_F2_Src1_YIVXCQSW	5		-85		-12.8	1	5			
B1_F2_Ant5	B1_F2_Src1_YIVXCQSW	3		-85		-13.8					
B1_F2_Ant6	B1_F2_Src1_YIVXCQSW	3		-85		-15.8					
B1_F2_Ant7	B1_F2_Src1_YIVXCQSW	3		-85		-13.8					
B1_F2_Ant8	B1_F2_Src1_YIVXCQSW	3		-85		-14.6					
B1_F2_Ant9	B1_F2_Src1_YIVXCQSW	3		-85		-17.4					

Coupler											PowerSplitter		Cable
Tap Loss					Thru Loss						Loss		
Generic					Generic						Generic		Generic
T-07-NF			T-10-NF		T-05-NF		T-07-NF		T-10-NF		PS-02-NF		CAB-12F
6.999999(dB)	7(dB)		10(dB)		1.7(dB)		1(dB)		0.9000001(dB)		3.01(dB)		
Subtotal(dB)	Quantity	Subtotal(dB)	Quantity	Subtotal(dB)	Quantity	Subtotal(dB)	Quantity	Subtotal(dB)	Quantity	Subtotal(dB)	Quantity	Subtotal(dB)	Length(Feet)
	1	7			1	1.7	1	1					261
	1	7					1	1					147
7	1	7											226
							2	2	2	1.8			386
			1	10			1	1	1	0.9			200
					1	1.7	2	2	2	1.8	1	3	442
	1	7					1	1	2	1.8			296
			1	10			1	1					297
					1	1.7	2	2	2	1.8	1	3	522

Cable	Repeater		Connector	
	Loss		Loss	
Generic	Generic		Generic	
CAB-12F	RP-1W-NF		N-J1/2	
	-85(dB)			
Subtotal(dB)	Quantity	Subtotal(dB)	Quantity	Subtotal(dB)
5.1	1	-85	10	1
2.9	1	-85	10	1
4.4	1	-85	8	0.8
7.6	1	-85	14	1.4
3.9	1	-85	10	1
8.7	1	-85	16	1.6
5.8	1	-85	12	1.2
5.8	1	-85	8	0.8
10.3	1	-85	16	1.6

1.4 KEY EQUIPMENT LIST REPORT- ESTIMATED*

Manufacturer	Name	Type	Comments	Quantity	Unit
Generic	CAB-12F	Cable	1/2" Flexible Foam Dielectric Coaxial Cable	1192	Feet
Generic	N-J1/2	Connector	1/2" Cable N-Type Male connector	36	-
Generic	T-10-NF	Coupler	10 dB Coupler - 800-6000 MHz - N-Female	2	-
Generic	PS-02-NF	PowerSplitter	2-Way Splitter - 100-6000MHz - N Female.	1	-
Generic	T-05-NF	Coupler	5 dB Coupler - 800-6000 MHz - N-Female	2	-
Generic	T-07-NF	Coupler	7 dB Coupler - 800-6000 MHz - N-Female	3	-
Generic	ANTD-1005_17007	Directional Antenna	Directional Indoor Antenna, 100+ MHz 5 dBi Gain, 1700+ MHz 7 dBi Gain.	1	-
Generic	Donor Site_3GPP	Source	Donor site for repeater solution - 3GPP. Max Output power 23 dBm.	1	-

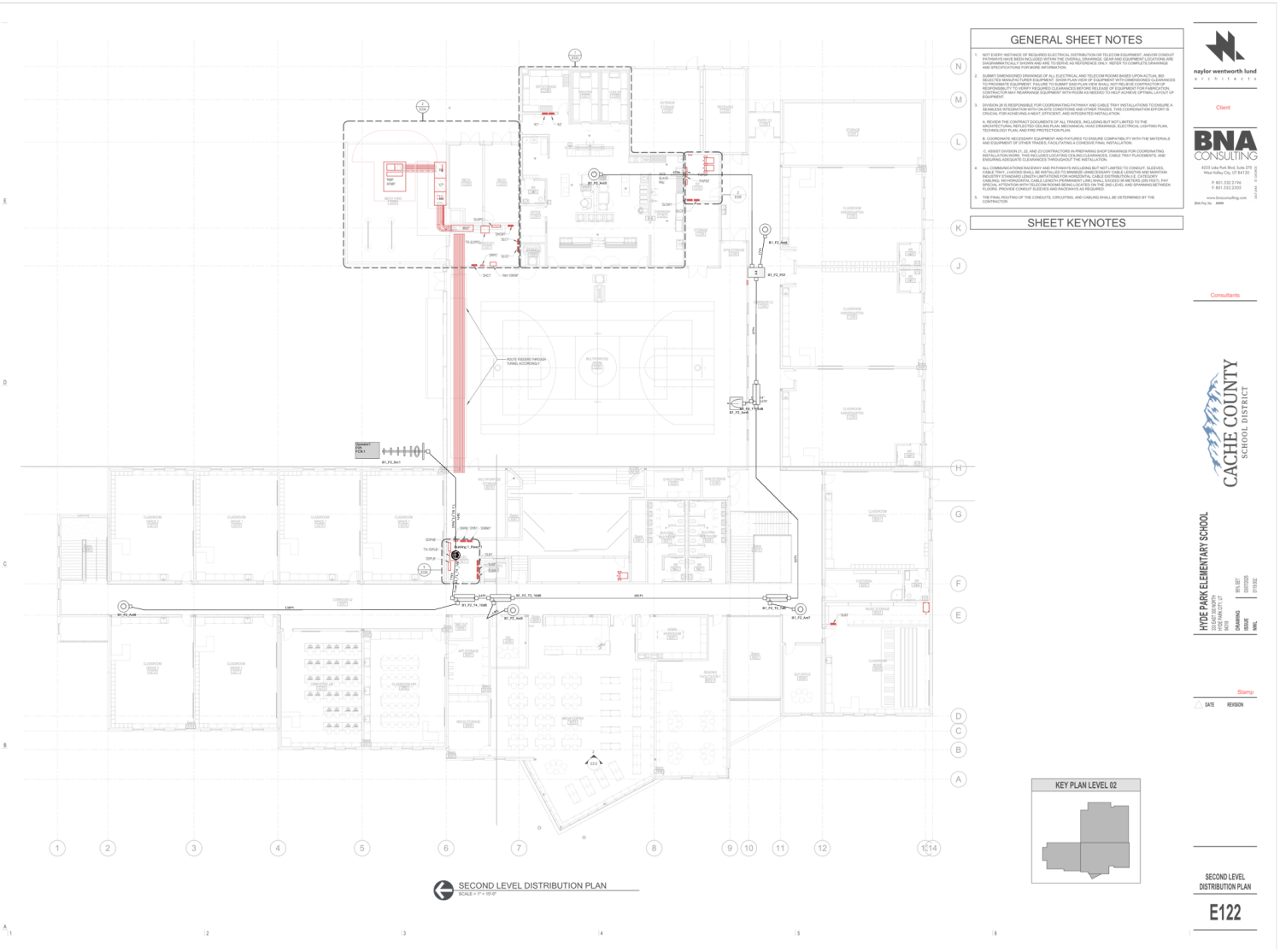
Manufacturer	Name	Type	Comments	Quantity	Unit
Generic	ANTO_1003	Omni-directional Antenna	Omnidirectional Indoor Antenna, 100-6000 MHz 3 dBi Gain.	8	-
Generic	RP-1W-NF	Repeater	Wireless Band Repeater 1 Watt (30dBm) - N-Female.	1	-

Equipment listed “Generic” for illustrative purposes only. Equipment must be approved as outlined in section 1.1.

1.5 DEVICE LOCATION LAYOUT



Plan Name	PRELIMINARY ERCES DESIGN- MAIN LEVEL	Date	03/23/2025		
Project Name	HYDE PARK ELEMENTARY ERCES 700/800MHz				
Designer Name	SH			Company Name	GROOVE TECHNOLOGY SOLUTIONS



Plan Name	PRELIMINARY ERCES DESIGN- SECOND LEVEL	Date	03/23/2025		
Project Name	HYDE PARK ELEMENTARY ERCES 700/800MHz				
Designer Name	SH			Company Name	GROOVE TECHNOLOGY SOLUTIONS

1.6 EQUIPMENT DATA SHEETS

NEXTIVITY
Smarter by Design

Data Sheet

SHIELD EXTEND

Scalable Public Safety ERCES

MODEL NUMBERS:
MU: F40-0E; (Class A) NU: F42-67ENU, CU: F41-8XCU; (Class B) NU: F42-67ENUB, CU: F41-8XCUB

SHIELD EXTEND is a public safety ERCES that solves for the toughest emergency communication challenges and delivers consistent coverage in any building. Available in Class A or Class B variations, EXTEND is built upon Power-over-Ethernet (PoE) architecture and includes a Network Unit (NU), Coverage Unit (CU), and Management Unit (MU). The system is scalable to fit buildings of all sizes and compatible with additional equipment such as the SHIELD EXTEND Battery Backup Unit and Fiber Range Extenders, the SHIELD Remote Annunciator, Emergency Power-Off Switch, and Active Server Antennas, as well as third-party public safety options.

SHIELD EXTEND is the only ERCES to concurrently provide 700/800 MHz Land Mobile Radio (LMR) coverage and true carrier-grade support for all FirstNet bands. In addition to delivering industry-leading talk-in and talk-out performance with a no noise guarantee, EXTEND is listed to UL 2524 and complies with IFC 510 and NFPA 1221. The system also works alongside the Nextivity WAVE PRO App and WAVE Portal for seamless installation and robust remote monitoring and management capabilities.



FIRSTNET. Built with AT&T

SAFER BUILDINGS COALITION Member

Features and benefits include:

- ERCES Public Safety Solution: 700/800 MHz LMR and FirstNet
- Class A Device: 56 Channels at 12.5 kHz Bandwidth
- Class B Device: 28 Channels at 100 kHz or 150 kHz Bandwidth
- No Noise Guarantee: Automatic Calculation and Setting of Isolation as well as Uplink and Downlink Gain
- Talk-Out and Grid Testing: Industry-First Uplink and Downlink Tests via Nextivity WAVE PRO App and COMPASS XR
- Nextivity Proprietary IntelliBoost Chip: Delivers Unparalleled Real-Time Talk-In and Talk-Out Performance
- End-to-End System Monitoring: Built-in Remote Monitoring and Management via Nextivity WAVE Portal
- Management Unit: Controls and Monitors all System Components, including NU and CU as well as SHIELD Remote Annunciator Panel (RA), Emergency Power-off Switch (EPO), and Active Server Antennas
- Network Unit: Head-End of the System; Suports up to 6 CUs via PoE
- Coverage Unit: Remote Unit of the System that Rebroadcasts LMR and FirstNet Donor Signals

System Features

Real-time automatic gain control (AGC) per time-slot
PoE architecture allows 325 ft distance range between the NU and the CUs
Up to six (6) CUs can be attached to a single NU
Remote monitoring through Nextivity WAVE PRO app and WAVE Portal

Public Safety Network and Network Protection Features

Support for all FirstNet LTE bands (2, 4, 12, 14)
Support for 700 MHz and 800 MHz (P25, Analog)
NFPA 1221, IFC 210, NEMA 4 certified, listed to UL 2524
Automatic UL and DL gain setting for Public Safety Channels
Uplink Muting Mode (Squelch) automatically shuts down uplink transmissions when no active user equipment is detected
Independent donor antenna ports for FirstNet and LMR

Benefits

One solution provides a complete code-compliant ERCES system
Centralized Power-over-Ethernet (PoE) architecture reduces equipment costs
Modular architecture allows scaling the system from 1W to 6W
Certifications reduce time-to-market and downstream costs
Remote monitoring assures that the system is performing per design
Minimal noise in network through optimal gain and power settings ensure best overall radio performance
Assured best audio quality

Power

Band Configuration	Consumption (Watts) @ 48 VDC					
	1X CU	2X CU	3X CU	4X CU	5X CU	6X CU
FirstNet + 700/800 MHz LMR	102	161	220	279	338	397
Input voltage	110 VAC					
Output voltage	54 VDC					

Environmental

54 VDC
Product Ingress Protection (IP) Rating
Relative Humidity
Maximum Surface Temperature (any point)
-4 to 122°F (NU-CU) / 32-122°F (MU)
NEMA 4
0% to 95%, noncondensing
44°C @ 30°C ambient / 111°F @ 86°F

Installation

Mounting hardware included
NU and CU can be wall mounted
1 NU supports 1 to 6 CUs
iBwave VEX files available

Radio Performance

Band	2(LTE)	4 (LTE)	12 (LTE)	14(LTE)	700 (LMR	800 (LMR)
Frequency Range, Downlink (MHz)	1930–1990	2110–2155	728–746	758–768	768–775	851–861
Frequency Range, Uplink (MHz)	1850–1910	1710–1755	699–716	788–798	798–805	806–816
Technology	LTE–20 MHz	LTE–20 MHz	LTE–10 MHz	LTE–10 MHz	P25/Analog	P25/Analog
DL (Downlink) Output Power (dBm)	24					30
UL (Uplink) Output Power (dBm)	23		21	23		26
Minimum Input level (DL/UL) dBm	-100 / -90					
Maximum Input level (DL/UL) dBm	-20 / 0			-20 / -35		-20 / -27
System maximum gain (dB)	100					
Noise Figure at max gain (dB)	5					
Return loss (dB)	-8					
System Group Delay @ 12.5 kHz (usec) (Class A)	28					
System Group Delay @ 100 kHz / 150 kHz (usec) (Class B)	15 / 13.6					

Physical Specifications

	Width	Height	Depth	Weight
NU	12.36 in	14.61 in	4.29 in	15.43 lb
CU	11.18 in	13.50 in	3.50 in	12.13 lb
MU	10.63 in	12.20 in	4.80 in	8.82 lb

Connections (NU)

2x Donor antenna ports – Type-N female connectors
2x Donor antenna ports – Type-N female connectors
1x RJ45 LAN management output port (10/100 Fast Ethernet)
1x SFP+ Optical port, 5 Gbps, up to 6500 ft range from NU1 to NU2

Connections (CU)

1x Server antenna port – Type-N female connectors
2x RJ45 Proprietary Gigabit link, 300 ft range from NU to CU

Connections (MU)

LAN Port:	RJ45	PoE Port Power:	10W
Port Capability:	10 Mbps	Antenna Port:	SMA

Supported Alarms

• Normal AC power	• Battery Charger Fail
• Donor Antenna Disconnection	• System Component Malfunction
• Loss of Normal AC power	• Low Battery Capacity @ 30% of Capacity
• Active RF Emitting Device Malfunction	• Donor Antenna Malfunction

Certifications

FCC Part 15, 22, 24, 27, 20, 90	Listed to UL 2524	UL 50E (CU)
	IFC 510	NEMA 4
	NFPA 1221	ISED (Canada)

System Management (Software)

Nextivity WAVE PRO mobile app
Antenna aiming (Cellular only)
Nextivity WAVE Portal: Status (list and map), Commissioning, Diagnostics, Software Updates, Settings, Reporting, Alarms and Notifications

Patents and Design

Nextivity products are covered by multiple Nextivity, Inc., patents and pending patents.
Designed by Nextivity, Inc. in San Diego, California, USA.

Ordering Information

Model Numbers	Product Description
F40-0E	SHIELD EXTEND MU, FirstNet + 700/800 MHz LMR (Class A or Class B)
F42-67ENU	SHIELD EXTEND NU, FirstNet + 700/800 MHz LMR (Class A)
F41-8XCU	SHIELD EXTEND CU, FirstNet + 700/800 MHz LMR (Class A)
F42-67ENUB	SHIELD EXTEND NU, FirstNet + 700/800 MHz LMR (Class B)
F41-8XCUB	SHIELD EXTEND CU, FirstNet + 700/800 MHz LMR (Class B)

NEXTIVITY
Smarter by Design

nextivityinc.com/shield-extend

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SECTION 31 0000

GEOTECHNICAL INVESTIGATION

PART 1 GENERAL

1.01 SUMMARY

A. Geotechnical Investigation
   1. The Contractor shall examine the attached Geotechnical Reports. The investigations are bound in this Project Manual and follows as 31 0200.
   2. The Contractor shall become fully aware of the natural conditions that exist and are noted in the investigations.
   3. The Contractor shall be aware that due to the nature of existing subsoils, special precautions are noted and should be observed.
   4. If any conflicts occur between the construction documents and this report, the report shall govern.

1.02 GENERAL SITE INFORMATION

A. The Contractor shall examine the site personally to ascertain the state thereof and to understand the complexities of the Work. The Contractor shall compare the site with the drawings and the Geotechnical Investigation, and become familiar with the conditions of the premises, the actual elevations, existing obstructions, areas of work and other conditions that would affect the completion of the work.

B. The Contractor shall observe soil conditions throughout the duration of the site work operations and shall notify the Architect of any deviation in actual soil conditions from those expected based on the Geotechnical Investigation bound herein.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 31 0000

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ACache Corp

Engineering a Firm Foundation

Geotechnical Investigation
for the proposed
New Hyde Park Elementary School
350 E 300 N
Hyde Park, UT

PREPARED FOR:
Cache-Landmark Engineering, Inc.
Care of:
Lance Anderson
95 Golf Course Rd
Logan, UT 84321

PREPARED BY:
ACache Corp.
PROJECT NO.

September 30, 2024

September 30, 2024

Attn. Lance Anderson
Cache-Landmark Engineering, Inc.
95 Golf Course Rd
Logan, UT 84321

Subject: **Geotechnical Investigation for the proposed New Hyde Park Elementary School 350 E 300 N Hyde Park, UT 84318**

ACache Corp. Project No. 1240015

Mr. Anderson,

It is with great pleasure that ACache Corp. presents this report of our findings for the subject site. It contains the results of our findings and an engineering interpretation of the results with respect to the available project characteristics.

We appreciate the opportunity of working with you on this project and look forward to future projects with you. If you have questions regarding this project, or any other, please do not hesitate to contact us at **(435)-760-3103**.

Sincerely,

ACache Corp.



Jay E. Apedaile, P.E. M.S.
President

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Tele. (435) 760-3103 ● Fax (614) 883-9419 ● email: acachecorp@yahoo.com

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APPENDIX

Figure 1: Vicinity Map
Figure 2: Site Map
Figure 3: Symbol Legend
Figures 4-15: Borehole Logs
Figures 16-17: CPT Logs

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1.0 GENERAL PROJECT INFORMATION

1.1 Project Authorization

ACache Corp. (ACC) was retained by Lance Anderson of Cache-Landmark Engineering Inc. to provide a Geotechnical Report with design values for the proposed New Hyde Park Elementary School at approximately 350 E 300 N Hyde Park, UT (see **Figures 1 and 2** in the Appendix).

1.2 Project Purpose and Description

The purpose of this study and report was to obtain design level soil information to be used in the planning and design of a proposed new elementary school in Hyde Park, UT. Based on the information provided by Cache-Landmark, Inc. the proposed construction will consist of the development of approximately 9.7 acres for some school buildings, parking lots, playing field, access roads. The main school building is a slab on grade two story structure with high ceiling gymnasiums. Structural loads are anticipated to consist of column loads ranging from 10 to 250 kips, and wall loads ranging from 2.0 to 18 kips per linear foot, for dead plus live loads. Final site grading information was not provided. ACC has assumed that the floor slab of the buildings will be placed at or below the current elevation of the site.

This report and the recommendations herein are based on the available project information. If this information is incorrect, then ACC shall be informed, preferably in writing, so ACC can evaluate the validity of this report.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Investigation

The site is located in the middle of the block bounded on the north by 450 North, on the south by 300 North, on the east by 400 East and on the west by 225 East in Hyde Park Utah (see **Figures 1 and 2** in the Appendix). The proposed structures and parking lots will be placed in the open field that was there at the time of this report. Test hole locations are estimated and shown on Figure 2 in relation to existing structures.

The general subsurface conditions at the site were investigated by performing 9 Hollow Stem Auger borings, ACache Corp. conducted these borings in 2008 as a preliminary investigation to assess the site, they were conducted to depths ranging from 16.5 feet to as deep as 51.5 feet below site grade. In addition Cone Penetrometer Testing Seismic (CPTS) were conducted to refusal in 2 locations. The approximate location of each explored location is

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shown in **Figure 2** in the Appendix. Logs of the soil explorations are presented in the appendix as Figures 4 through 17.

3.0 FINDINGS

3.1 Site Conditions

At the times of this investigation the site was a grassy field. The surface consisted of eight to twelve inches of topsoil with alfalfa growing and being watered in 2008 and then dried grass in 2024.

3.2 Surface Drainage

Surface runoff would drain off the field from east to west. The soil conditions appear to be adequate in keeping the surface soils from eroding.

3.3 Geology

The site is mapped and appears to consist of surface soils formed from post-Lake Bonneville alluvial-fan deposits consisting of clast supported pebble and cobble gravel, locally bouldery, in a matrix of sand, silt and clay; poorly sorted on the east end of the site and of coarse to fine lacustrine sands and silt related to the Provo and younger shoreline.

3.4 Soil Profile

The soil profile at the site appeared to be somewhat consistent across the proposed building site with some variations. A typical profile encountered consists of TOPSOIL consisting of CLAYEY SAND to 8 to 12 inches below the current grade. Below the Topsoil a dense, GRAVEL and COBBLE layer was observed to approximately 5 feet below grade. Followed by medium dense SAND and GRAVEL to approximately 20 feet, this is underlain by clays and silty clays down to about 45 feet where a medium dense sand with layers of gravely clay was observed to the full depth explored (approximately 52 feet below current grade).

For detailed observations of the sub-soils, the location they were observed, the characteristics observed, and any other pertinent information observed in the field or in the laboratory, see the Logs in the Appendix.

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3.5 Fault and Seismicity

The site is located in a seismically active region. It is approximately 1.5-miles west of a mapped section of the Utah East Cache Fault scarp, as depicted on the Surficial Geologic Map of the East Cache Fault Zone (James McCalpin, 1989). During the life of the project seismic activity caused by active faults in the area have the potential of causing moderate to strong shaking. According to the findings of seismic shear wave analysis our subsurface investigation, and according to the guidelines of the International Building Code (IBC, 2023), the Site Class would be **Site Class D** (ASCE 7, Section 20).

3.6 Ground Water

Ground water was not encountered in the initial investigation in 2008 when standpipes were installed in many of the borings. Additionally, no groundwater was observed in the CPTS's. A detailed evaluation of groundwater fluctuations for the site is beyond the scope of this investigation.

Testing was conducted in the location of the proposed detention area IT-01 on Figure 2 in the appendix. Testing indicated an infiltration rate of 2-in/hr. We recommend using a maximum infiltration rate of **0.8 inch per hour** for design of the retention basin that extends at least 2 feet into the native soils. We also recommend that a representative from our office be obtained to inspect the exposed soils to assure that they adequate for that recommended rate.

3.7 Liquefaction Evaluation

A site-specific liquefaction assessment was conducted using the CPT data obtained in our field exploration. Given the conditions observed at the time of our investigation the native soils have a **low probability** of liquefaction**.**

3.8 Site Subsurface Variations

It is our experience that variations in continuity and nature of subsurface conditions should be anticipated. Due to the nature and depositional characteristics of soils encountered at the site, care should be taken in interpolating or extrapolating subsurface conditions beyond the exploratory locations. Seasonal fluctuations in ground water conditions are likely to occur.

4.0 RECOMMENDATIONS

Recommendations have been developed based on the previously described project characteristics and subsurface conditions observed in the field and laboratory, as well as common engineering practice. Prudence and common engineering practices should be followed in conjunction to the recommendations of this report.

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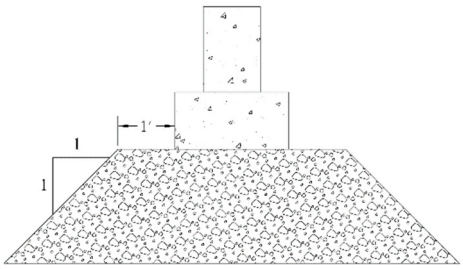
4.1 Site Preparation and Grading

All topsoil, vegetation, construction debris, unsuitable soils, fill, and any other deleterious materials, should be removed from areas of new construction. This material shall not be used as structural fill. After stripping and excavation to the proper subgrade elevation, the exposed subgrade should be proof rolled with a heavily loaded rubber-tired vehicle. Soils that rut, or tend to deflect excessively, should be removed and replaced with properly compacted fill. Proof rolling and removal of pumping material should be witnessed by the geotechnical engineer, or his approved representative. **For best results this should take place during a period of dry weather.** The subgrade soils should be compacted to a minimum of 95 percent Modified Proctor maximum laboratory density (ASTM D 1557) at a moisture content ranging from -2 to +5 percentage point of optimum.

4.2 Foundation Recommendations

Conventional spot and continuous wall foundations may be used for the support of the proposed structure at the subject site. Based on field and laboratory data an **allowable bearing capacity of 3.0 kips/ft^2** may be used **for continuous** wall and **spot** foundation design, provided the following recommendations are observed:

- Foundations shall be placed on native undisturbed or compacted soils or compacted structural fill (conforming to Sections 5.2 and 5.3).
- Onsite soils shall be examined by a qualified geotechnical engineer from this office, to verify that all topsoil, construction debris, soft spots, and any other deleterious materials have been removed prior to the placement of footings or structural fill.
- Structural fill shall be a well-graded granular soil, free of organics, debris, or other deleterious materials as outlined in Section 5.3.
- Structural fill shall be compacted as outlined in Section 5.3.
- Structural fill shall extend as a minimum 1-foot past the edge of the footing, and then for every 1-foot of fill (vertically) placed below the footing, it shall extend a minimum of 1-foot horizontally.



- Continuous footing width shall be maintained at a minimum of 18 inches. If continuous footing width greater than 6 feet is required, then that footing should be evaluated by an engineer from this office.
- Spot footings shall be a minimum of 2 feet in width. If spot footing width greater than 11 feet is required, then that footing should be evaluated by an engineer from this office.
- Exterior footings shall be placed a minimum of 30 inches below final grade, and interior footing shall be placed a minimum of 16 inches below grade for frost protection.

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Allowable bearing pressure may be increased by 1/3 for temporary loads such as wind but not for seismic forces. Foundations designed and constructed in accordance with our recommendations could experience some settlement. If the recommendations provided herein are observed, we estimate settlement should not exceed one inch, with differential settlements on the order of one-half inch. We anticipate approximately 75 percent of initial settlement to take place during construction.

4.3 Lateral Soil Pressures

Lateral soil pressures are dependent on the type of soil present. For the native silty sands and gravel the following lateral soil pressures shall be used for design:

1. An equivalent fluid pressure of 36 pounds per cubic foot (pcf) for the active case. That is when the structure is allowed to yield, that is to say the structure is allowed to move away from the soil. This requires a minimum movement or rotation at the top of the wall of 0.001H, where "H" is the height of the wall (bottom of footing to top of wall).
2. 56 pcf for the at-rest case. That is when the wall is not allowed to yield.
3. 390 pcf for the passive case. That is when the wall exerts pressure on the soil.
4. A coefficient of friction of 0.391 shall be used for the interface between the native sand and gravel and the cast-in-place concrete.

We recommend any slops made with native soils be greater or equal to 1.5 horizontal to 1.0 vertical.

4.4 Drainage

For constructability, adequate surface drainage should be provided at the site to minimize any increase in moisture content of the foundation supporting soils during and after construction. Foundation soils shall be protected from any increase in moisture.

4.5 Floor Slabs

All topsoil and deleterious materials shall be removed. We recommend a minimum of 4 inches of free draining structural fill, free from organic material and debris, be used just below floor slabs as a vapor barrier.

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4.6 Pavements

We expect site traffic to consist primarily of lightweight vehicle and pedestrian traffic. Both flexible and ridged pavement design options are provided below. The following minimum recommended pavement sections are based on an estimated CBR of 10.0%:

Option #1	**Flexible Pavement Design Section Thickness (in)**				
Material	**Pedestrian Traffic**	**Light Traffic**	**Main Drive**	**Dumpster Pad and Approach**	**Road Way**
Asphalt Pavement	**-**	**3**	**3**		**3**
Concrete Pavement	**4**	**-**	**-**	**6 reinforced**	
Road-Base Material	**-**	**4**	**4**	**-**	**4**
Sub base	**6**	**8**	**16**	**8**	**16**
Total Thickness	**10**	**14.5**	**23**	**14**	**23**

To insure a long life of the asphalt, water should be directed quickly off of the asphalt and into a concrete gutter or drain. **The asphalt pavement should be compacted to 96% of the maximum density for the asphalt material.**

Option #2	**Rigid Pavement Design Section Thickness (in)**			
Material	**Pedestrian Traffic**	**Light Traffic**	**Main Drive, Road Ways**	**Dumpster Pad and Approach**
Concrete Pavement	**4**	**5**	**5**	**6 reinforced**
Road-Base Material	**-**	**-**	**-**	**-**
Sub base	**6**	**6**	**8**	**8**
Total Thickness	**10**	**11**	**13**	**14**

The concrete shall have a minimum compressive strength of 3,500 psi. at 28 days. It should also have 5 $\pm$ 1 percent entrained air for durability and workability. A fiber mesh is also recommended to enhance the durability of the concrete. To reduce the potential for cracking, appropriate construction joints are required. Joints shall be designed in accordance with current Portland Cement Association guidelines. Joint shall be sealed to infiltration into pavement joints.

It is further recommended that all topsoil and fill materials are removed prior to the placing of base material, and structural fill. The native soils shall be proof rolled as outlined in Section 4.1. If any areas appear soft, they should be removed and replaced with structural fill. **All structural fill materials overlying native soil should be compacted in accordance with Section 5.2 of this report.**

If grade allows pavement to be placed on native granular (gravels) soils then a sub-base material may not be required. Soils shall be approved by an engineer from this office. All native soils shall be proof rolled with a heavily loaded rubber-tired vehicle. Soils that rut,

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or tend to deflect excessively, should be removed and replaced with properly compacted fill.

5.0 GENERAL CONSTRUCTION CONSIDERATIONS

The guidelines and recommendations outlined below address the geotechnically related construction considerations for this project.

5.1 Foundation Excavations

All areas that will support foundation loads should be inspected by the geotechnical engineer, or his approved representative, to ensure that all loose, soft, or otherwise undesirable material is removed, and that the structure will bear on satisfactory material. This shall occur prior to the placement of any structural fill or concrete. (We recommend giving this office a few days notice for scheduling.) Any loose or deleterious material should be replaced with well-compacted structural fill as outlined in **Sections 5.2 and 5.3**.

If unsatisfactory material pockets are encountered in the excavation, the undesirable material should be removed, and the elevation re-established by backfilling. This backfilling can be done with a lean concrete, or a well-compacted structural fill as define in **Section 5.3**.

All structural fill supporting footing loads should be compacted to at least 95 percent of the Modified Proctor Maximum Density (ASTM D 1557), provided the foundation is designed as outlined in **Section 4.2**. Compaction tests should be taken on each lift to ensure the required compaction is being achieved.

Foundation excavations shall be protected against any harmful change in condition such as disturbance, rain, and freezing. Surface runoff should be directed away from the excavation and not allowed to pond. Ideally all footing concrete should be poured the same day as the excavation is made. If this is not practical, the foundation excavation should be adequately protected, and foundation placement should take place as soon as possible. For best construction results we recommend that earth work be conducted during the dry months of the year, typically June through September.

Excavation slopes shall maintain a maximum slope of 1.5 horizontal to 1 vertical. It may be possible to have steeper slopes for temporary excavations. This will depend on the conditions location and precautions taken. Contact our office for further consultation. Otherwise, if it is required that slopes are steeper, it is necessary that excavation shoring/bracing be used.

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5.2 Fill Compaction

All fill material should be compacted in accordance to the following criteria based on the Modified Proctor Maximum Laboratory Density (ASTM D 1557):

1. Structural fill, supporting foundations.	95%
2. Structural fill, below floor stabs	94%
3. Backfill of trenches	
a. Below foundations	95%
b. Below floor stabs	94%
c. Below pavements	94%
d. Others	90%
4. Beneath Pavements	95%

Compaction should be accomplished by placing the fill in a maximum of 8-inch loose lifts, and mechanically compacting each lift to the specified minimum density. Field density tests should be performed on each lift as necessary to ensure that compaction is being achieved. As a minimum 33% of all spot footings, and one test for every 50 lineal feet of continuous wall footings shall be tested for each lift.

5.3 Types of Fill

5.3.1 Structural Fill: Sub-base (pit-run)

Well-graded granular soils free of organics, debris, or other deleterious materials are recommended for use as structural fill at this site. We recommend a well-graded sandy gravel material with no less than 5%, and no more than 10% passing the #200 sieve, and no particles greater than 4 inches in maximum dimension. Structural fill shall be compacted at a moisture content ranging from -2 to +6 percentage point of optimum in accordance to the Modified Proctor Maximum Laboratory Density (ASTM D 1557).

5.3.2 Structural Fill: Roadbase

Granular soils free of organics or other deleterious materials and debris. We recommend a sand and fractured gravel material with between 5 and 12 percent passing the #200 sieve, and no particles greater than approximately 1 inch in maximum dimension.

5.3.3 Non-Structural Fill

On-site soils appear to be suitable for non-structural site grading and landscaping fill. All fill material shall be approved by the engineer prior to placement.

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5.4 Quality Control

Our recommendations are based on the assumption that adequate quality control testing and observations will be conducted during construction to verify compliance. This may include but is not necessarily limited to the following:

5.4.1 Field observations

Observations during all phases of construction should occur. Observations such as site preparation, foundation excavation, structural fill placement, and concrete placement.

5.4.2 Fill Compaction

Compaction testing is required for all Structural supporting fill materials. Maximum Dry Density (Proctor-ASTM 1557) tests should be requested by the contractor immediately after delivery of any granular fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

5.4.3 Concrete Quality

We recommend that freshly mixed concrete be tested in accordance with ASTM designations as follows:

- Slump, Temperature, Unit Weight, and Yield testing should be conducted on every delivery truck (ASTM C 138 and C 143).

- Entrained Air testing should also be conducted on every delivery truck for exposed concrete or concrete placed above the frost line (ASTM C 231).

- Test cylinders should be taken a minimum of every 50 cubic yards. Cylinder compressive strength tests should be conducted at 7 and 28 days from the placement date (ASTM C 31).

6.0 LIMITATIONS

The recommendations submitted in this report were based on evaluating the information obtained from the borings and site investigation, and the design details furnished by Cache-Landmark Engineering Inc. for the proposed project. The borehole data reflects the subsurface condition only at the specific location at the time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploratory location. The nature and extent of any variation may not become evident until construction begins. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation. If ACache Corp. is

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not notified of changes to the project or variations of the soils, ACache Corp. will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specification, or professional advice contained herein, have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

Once the plans and specifications are more complete, the Geotechnical Engineer shall be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At this time, it may be necessary to submit supplementary recommendations. If ACache Corp. is not retained to perform these functions, ACache Corp. will not be responsible for the impact of those conditions on the project. This report has been prepared for the exclusive use of Cache-Landmark Engineering Inc for the specific use of the proposed New Hyde Park Elementary School project in Hyde Park, Utah.

7.0 REFERENCES

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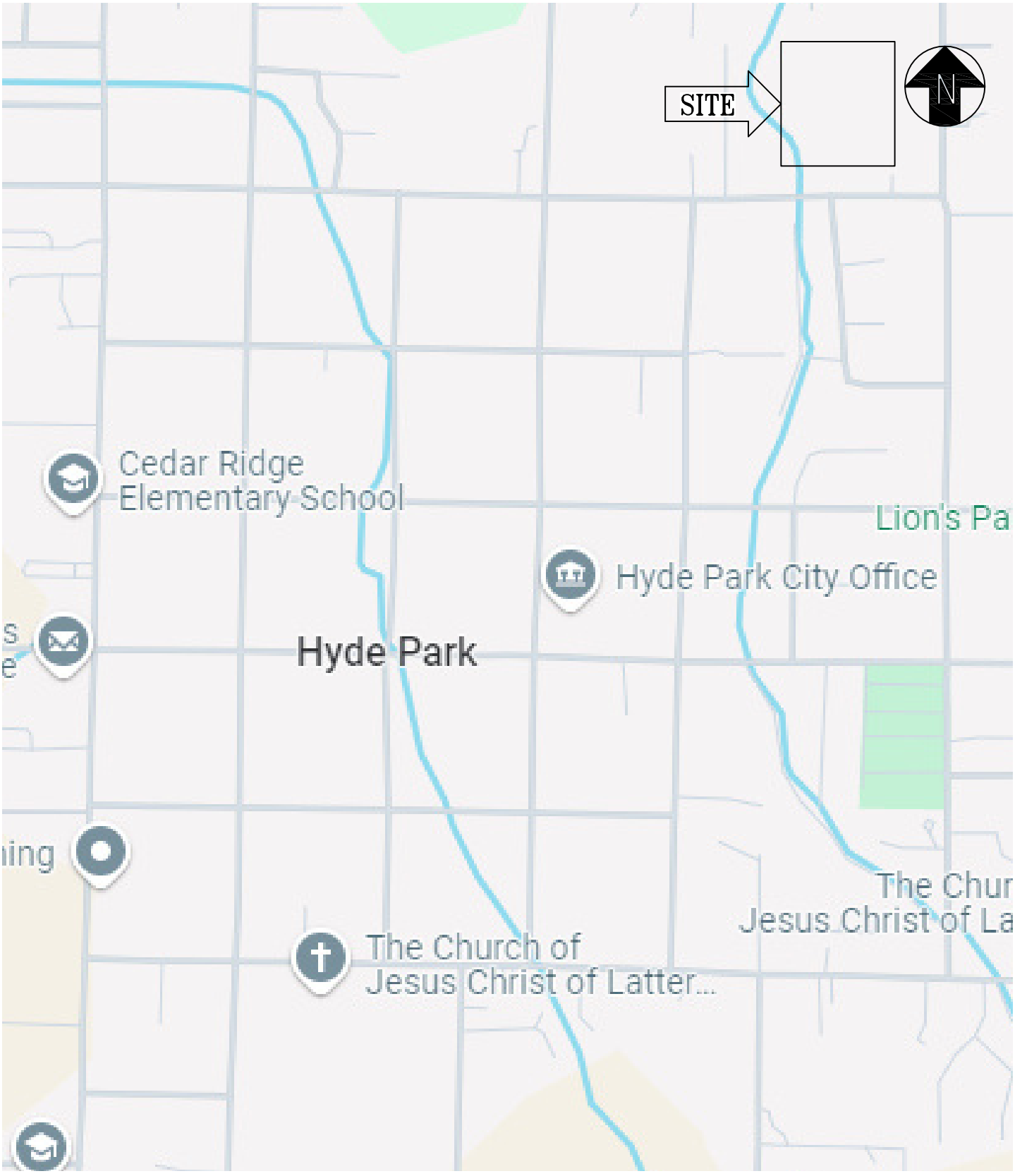
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APPENDIX





Google 2022

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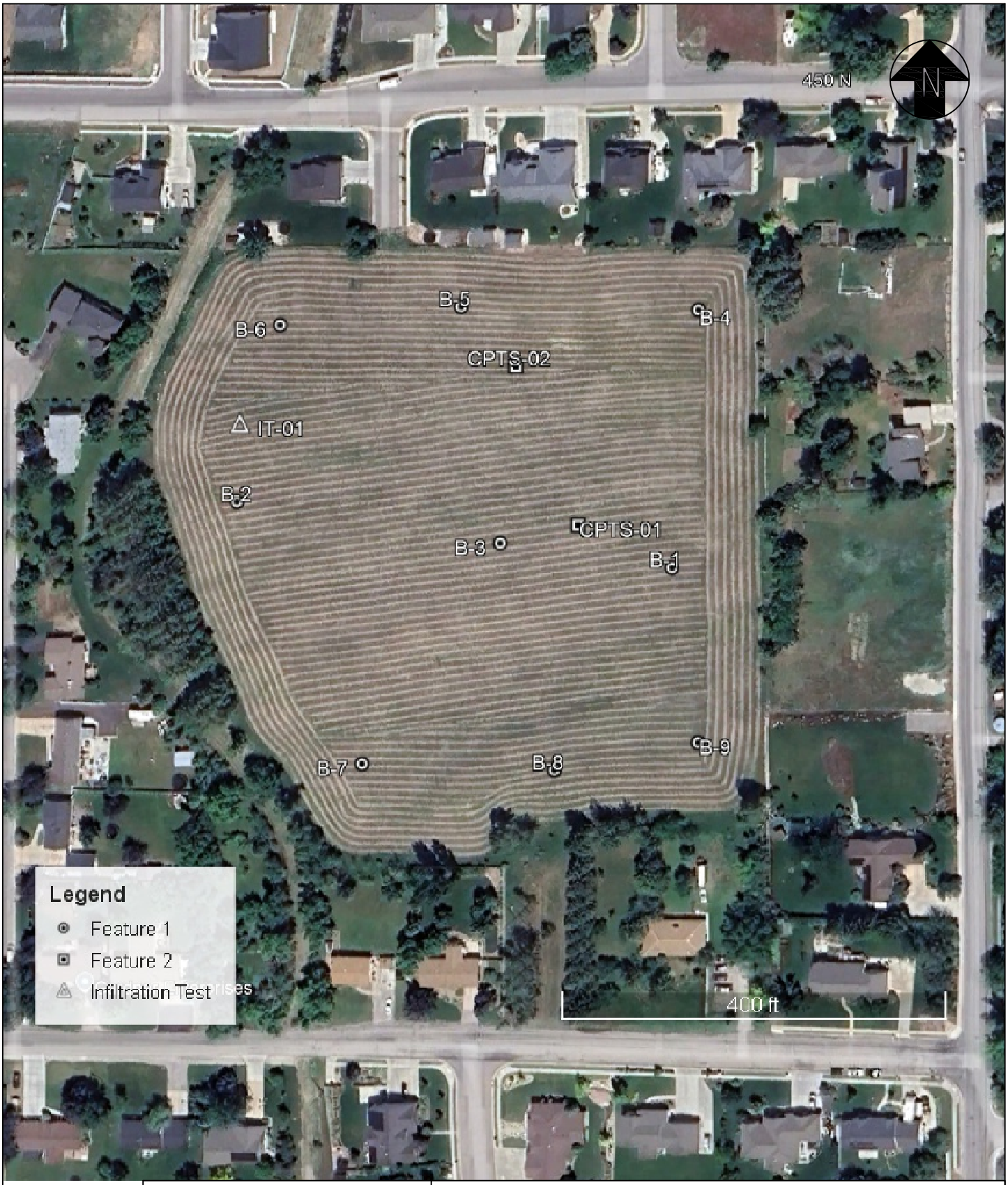
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Hyde Park School Site

350 E. 300 N. Hyde Park, UT

TITLE:	Vicinity Map		
SCALE:	No Scale	ENGINEER: J. Apedaile	DRAWN BY: R. Hendrix
DATE:	9/20/2024		
DRAWING NO.	1240015_Figures.dwg		

FIGURE 1



UTAH

Google 2022

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Hyde Park School Site

350 E. 300 N. Hyde Park, UT

TITLE:	Site Map
SCALE:	No Scale
DATE:	9/20/2024
DRAWING NO.	1240015 Figures.dwg

ENGINEER:	DRAWN BY:
J. Apedaile	R. Hendrix

FIGURE 2

UNIFIED SOIL CLASSIFICATION SYSTEM

FIELD IDENTIFICATION PROCEDURES				GRAPH SYMBOL	LETTER SYMBOL [1]	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size. [2] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
	SANDS More than half of coarse fraction is smaller than No. 4 sieve size. (For visual classifications, the 1/4" size may be used as equivalent to the No. 4 sieve size.)	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes.		SW	Well graded sands, gravelly sands, little or no fines.
			Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	Poorly graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	Silty sands, poorly graded sand-silt mixtures.
			Plastic fines (for identification procedures see CL below).		SC	Clayey sands, poorly graded sand-clay mixtures.
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE					
		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)		
	SILTS AND CLAYS Liquid limit less than 50	None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sand with slight plasticity.
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS Liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays.
		Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other highly organic soils.

[1] Boundary classifications: –Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW–GC, well graded gravel–sand mixture with clay binder.
[2] All sieve sizes on this chart are U.S. standard.

GENERAL NOTES

1. In general, Unified Soil Classification Designations presented on the logs were evaluated by visual methods only. There rore, actual designations (based on laboratory testing) may differ.

2. Lines seperating strata on the logs represent approximate boundaries only Actual transitions may be gradual.

3. Logs represent general soil conditions observed at the point of exploration on the date indicated.

4. No warranty is provided as to the continuity of soil conditions between individual sample locations.

LOG KEY SYMBOLS

- Bulk / Bag Sample
- 2.0"Ø O.D. Penetration Split Spoon Sampler
- 2.5"Ø O.D.Penetration Split Spoon Sampler
- 3.0"Ø O.D. Penetration Split Spoon Sampler
- Shelby Tube
- Rock Core
- No Recovory
- Water Level (level after completion)
- Water Level (level where first encountered)

FINE - GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNDRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
Very Soft	<2	<0.125	<0.25	Easily penetrated several inches by Thumb. Squeezes through fingers.
Soft	2 - 4	0.125 - 0.25	0.25 - 0.5	Easily penetrated 1 " by Thumb . Molded by light finger pressure.
Medium Stiff	4 - 8	0.25 - 0.5	0.5 - 1.0	Penetrated over 1/2 " by Thumb with moerate effort. Molded by strong finger pressure.
Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0	Indented about 1/2 " by Thumb but penetrated only with great effort
Very Stiff	15 - 30	1.0 - 2.0	2.0 - 4.0	Readily indented by Thumbnail
Hard	>30	>2.0	>4.0	Indented with difficulty by Thumbnail

COARSE -GRAINDE SOIL

APPERENT DENSITY	SPT (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
Very Loose	<4	0 - 15	Easily penetrated with 1/2 " reinforcing rod pushed by hand
Loose	4 - 10	15 - 35	Difficult to penetrated with 1/2 " reinforcing rod pushed by hand
Medium Dense	10 - 30	35 - 65	Easily penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Dense	30 - 50	65 - 85	Difficult to penetrated a foot with 1/2 " reinforcing rod driven with 5-lb hammer
Very Dense	>50	85 - 100	Penetrated only a few inches with 1/2 " reinforcing rod driven with 5-lb hammer

STRATIFICATION

DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2 "
LAYER	1/2 - 12 "

DESCRIPTION	THICKNESS
Occasional	One or less per foot of thickness
Frequent	More than on per foot of thichness

CEMENTATION

DESCRIPTION	DESCRIPTION
Weakely	Crumbles or breaks with handling of slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumbles or breaks with finger pressure

MODIFIERS

DESCRIPTION	%
Trace	<5
Some	5 - 12
With	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible water, usually soil below Water Table

FIGURE 3

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BORING LOG

Hyde Park School Site

BORING No. : B-1	JOB No. : 1240015	DATE : 8/15/2008	SHEET 1 OF 2
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 51.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE; ⊖ RESIDUAL MINIATURE VANE; ⊗ POCKET PENETROMETER; ◑ UNCONFINED COMPRESSION(UU); ⊕ TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
			Surface~12": dark brown topsoil							
			Brown silty gravel w/ cobbles, GM		10					
5										
			5'-21' Brown Silty SAND and GRAVEL, (SM-GM): moist, medium dense to dense, some layering		16					
10										
					61					
15										
					10					
20										
			21'-42' Brown Silty SAND and GRAVEL (GM-SM), intermitten with layers of clay and silt, Clays are moist to wet, gravels are moist to dry, dense sand and gravel, to medium stiff clay.		45					
25										
					34					
30										
					6					
35										

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/15/2008

FIGURE 4

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-1	JOB No. : 1240015	DATE : 8/15/2008	SHEET 2 OF 2
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 51.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (MINIATURE VANE, RESIDUAL MINIATURE VANE, POCKET PENETROMETER, UNCONFINED COMPRESSION(UU), TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
40			21'-42' Brown Silty SAND and GRAVEL (GM-SM), intermitten with layers of clay and silt, Clays are moist to wet, gravels are moist to dry, dense sand and gravel, to medium stiff clay.		39					
45			42'-51.5' Brown silty CLAY (CL-ML), wet, soft, some sand and gravel mostly in layers.		5					
50					5					
			-End at 51.5'-							
55										
60										
65										
70										

REMARKS :
FIELD ENG.: Jay Apedaile

REMARKS : Standpipe installed to 45.3' no water measured 8/20/2008

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/15/2008

FIGURE 5

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-2	JOB No. : 1240015	DATE : 8/15/2008	SHEET 1 OF 1
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 21.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE; ⊖ RESIDUAL MINIATURE VANE; ⊗ POCKET PENETROMETER; ◒ UNCONFINED COMPRESSION(UU); ⊕ TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
			Surface~6": topsoil							
			6"-5' Dark Brown gravely SILT (ML); Medium stiff, moist to dry.		6					
5			5'-8' Brown to gray porly graded GRAVEL (GP); trace cobble, loose, dry.		55					
10			8'-21.5' Brown Silty SAND and GRAVEL, (SM-GM): moist, medium dense to dense, some silt and clay in layers.		11					
15										
20					65					
			-End at 21.5'-							
25										
30										
35										

REMARKS : Standpipe installed at 19.3' no water observed 8/20/2008

REMARKS :

FIELD ENG.: Jay Apedaile

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/15/2008

FIGURE 6

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Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-3	JOB No. : 1240015	DATE : 8/19/2008	SHEET 1 OF 1
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 36.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %
	Surface~10": topsoil w/ occasional rock					
	10"-5' Brown silty GRAVEL (GM); moist, rocky, cobbles and boulders encountered		52			
5						
10	5'-23' Brown silty SAND and GRAVEL (SM-GM), moist, dense, some layers of well graded cleen sands and gravel, sub rounded, trace cobbles.		37			
15			69			
20			68			
25			6			
30	23'-33' Light Brown SILT and CLAY (ML-CL), medium stiff, trace gravels, trace pinholes, moist.		12			
35	33'-36.5' Brown clayey GRAVEL (GC); with sand, medium dense, moist.		14			
	-End at 36.5'-					

SHEAR STRENGTH, TSF
- MINIATURE VANE
- RESIDUAL MINIATURE VANE
- POCKET PENETROMETER
- UNCONFINED COMPRESSION(UU)
- TORVANE

(OPEN SYMBOLS REPRESENT REMOLDED TESTS.)

1.0 2.0

WET/DRY UNIT WT.,lb/cu.ft.

REMARKS : Standpipe installed to 28.7' no water observed 8/20/2008

REMARKS :

FIELD ENG.: Jay Apedaile

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/19/2008

FIGURE 7

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-4	JOB No. : 1240015	DATE : 8/19/2008	SHEET 1 OF 2
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 41.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %
	Surface~12": brown topsoil					
	12"-5' Brown silty GRAVEL (GM); moist, rocky, cobbles encountered.		90			
5						
10	5'-19' LIght brown SAND and GRAVEL, trace silts and clay (GM-SM), dense, moist to dry, occasional cobble		60/4"			
15			52			
20			3			
25	19'-32.5' Light brown SILT and CLAY (ML-CL); trace gravel and sand in layers, soft to stiff, moist to wet.		2			
30	Heavy cementation at interface between fine soils and course lower soils.		20			
35	32.5'- 41.5' Brown silty SAND (SM), layered with clay and trace gravel, medium dense to stiff, moist.		11			

SHEAR STRENGTH, TSF
- MINIATURE VANE
- RESIDUAL MINIATURE VANE
- POCKET PENETROMETER
- UNCONFINED COMPRESSION(UU)
- TORVANE

(OPEN SYMBOLS REPRESENT REMOLDED TESTS.)

1.0 2.0

WET/DRY UNIT WT.,lb/cu.ft.

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/19/2008

FIGURE 8

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Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-4	JOB No. : 1240015	DATE : 8/19/2008	SHEET 2 OF 2
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 41.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE; ⊖ RESIDUAL MINIATURE VANE; ⊗ POCKET PENETROMETER; ◑ UNCONFINED COMPRESSION(UU); ⊕ TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
40			32.5'– 41.5' Brown silty SAND (SM), layered with clay and trace gravel, medium dense to stiff, moist.		9					
			–End at 41.5'–							
45										
50										
55										
60										
65										
70										

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/19/2008

FIGURE 9

A Cache Corp.
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BORING LOG

Hyde Park School Site

BORING No. : B-5	JOB No. : 1240015	DATE : 8/19/2008	SHEET 1 OF 1
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 31.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	WET/DRY UNIT WT.,lb/cu.ft.
	Surface~12": dark brown topsoil						
	1'-12' Brown, silty SAND, sandy SILT (SM-ML); layered, trace gravel, trace clay, medium dense to stiff, moist,		10				
5							
			9				
10							
			81				
15							
			22				
20	12'-31.5' Light Brown silty SAND and GRAVEL, (GM-SM), medium dense to dense, layers of silt, clay, and fine sand, trace cobble, moist.						
			27				
25							
			50/4"				
30							
	-End at 31.5'-						
35							

SHEAR STRENGTH, TSF
- MINIATURE VANE
- RESIDUAL MINIATURE VANE
- POCKET PENETROMETER
- UNCONFINED COMPRESSION(UU)
- TORVANE

(OPEN SYMBOLS REPRESENT REMOLDED TESTS.)

1.0 2.0

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/19/2008

FIGURE 10

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-6	JOB No. : 1240015	DATE : 8/20/2008	SHEET 1 OF 1
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 16.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE, ⊖ RESIDUAL MINIATURE VANE, ⊗ POCKET PENETROMETER, ◑ UNCONFINED COMPRESSION(UU), ⊕ TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
			Surface~8": topsoil							
5			8"-16.5' Brown silty SAND and GRAVEL (SM-GM): moist, medium dense, some layering		13					
10					25					
15					19					
			-End at 16.5'-							
20										
25										
30										
35										

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/20/2008

FIGURE 11

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-7	JOB No. : 1240015	DATE : 8/20/2008	SHEET 1 OF 1
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 16.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE, ⊖ RESIDUAL MINIATURE VANE, ⊗ POCKET PENETROMETER, ◑ UNCONFINED COMPRESSION(UU), ⊕ TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
			Surface~12": topsoil							
5			12"-16.5' Brown silty SAND and GRAVEL (SM-GM); layered, trace cobbel, dense, moist.		28					
10					71/6"					
15					37					
			-End at 16.5'-							
20										
25										
30										
35										

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/20/2008

FIGURE 12

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-8	JOB No. : 1240015	DATE : 8/20/2008	SHEET 1 OF 1
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 31.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE; ⊖ RESIDUAL MINIATURE VANE; ⊗ POCKET PENETROMETER; ◒ UNCONFINED COMPRESSION(UU); ⊕ TORVANE; OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0	WET/DRY UNIT WT.,lb/cu.ft.
			Surface~6": topsoil							
5					37					
10			6"-17' Brown silty GRAVEL and SAND (GM-SM); dense, layered, occasional cobble or boulder, trace clays		42					
15					37					
20			17'-27' Brown, sandy SILT and CLAY (ML-CL); layered with gravel, moist, very stiff to dense, moist.		35					
25					13					
30			27'-31.5' Brown, CLAY and SILT (CL-ML); with layers of snad and gravel, stff to medium stiff, moist.		7					
			-End at 31.5'-							
35										

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/20/2008

FIGURE 13

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-9	JOB No. : 1240015	DATE : 8/15/2008	SHEET 1 OF 2
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 41.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %
	Surface~8": topsoil					
5	8"-12' Brown silty GRAVEL and SAND (GM-SM), dense, moist occasional cobble.		51			
10			31			
15	12'-18' Brown SILT and CLAY (ML-CL), layers of fine sand and gravel, stiff, moist.		11			
20			60			
25	18'-41.5' silty GRAVEL and SAND (GM-SM); with clay, layered, moist to wet, dense to very dense.		78			
30			37			
35			80			

SHEAR STRENGTH, TSF
- MINIATURE VANE
- RESIDUAL MINIATURE VANE
- POCKET PENETROMETER
- UNCONFINED COMPRESSION(UU)
- TORVANE

(OPEN SYMBOLS REPRESENT REMOLDED TESTS.)

1.0 2.0

WET/DRY UNIT WT.,lb/cu.ft.

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/20/2008

FIGURE 14

A Cache Corp.
Engineering a Firm Foundation

BORING LOG

Hyde Park School Site

BORING No. : B-9	JOB No. : 1240015	DATE : 8/15/2008	SHEET 2 OF 2
PROJECT : 350 E. 300 N. Hyde Park, UT	SURF. EL. :	BORE DIA. :	DEPTH : 41.5
	WATER EL. :	COORDINATES:	
BORING TYPE : 4-1/4" HSA	CAD FILE : 1240015_Figures.dwg		

DEPTH, Ft.	GRAPHIC LOG	SAMPLE	SOIL DESCRIPTION	% FINER No. 200 SIEVE	BLOWS/Ft.	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE CONTENT, %	SHEAR STRENGTH, TSF (● MINIATURE VANE; ⊖ RESIDUAL MINIATURE VANE; ⊗ POCKET PENETROMETER; ◑ UNCONFINED COMPRESSION(UU); ⊕ TORVANE; (OPEN SYMBOLS REPRESENT REMOLDED TESTS.) 1.0 2.0)	WET/DRY UNIT WT.,lb/cu.ft.
40			18'-41.5' silty GRAVEL and SAND (GM-SM); with clay, layered, moist to wet, dense to very dense.		34					
			-End of hole-							
45										
50										
55										
60										
65										
70										

REMARKS :

FIELD ENG.: Jay Apedaile

REMARKS :

WTR DEPTH @ COMPL. : Not encountered

COMPLETION DATE : 8/20/2008

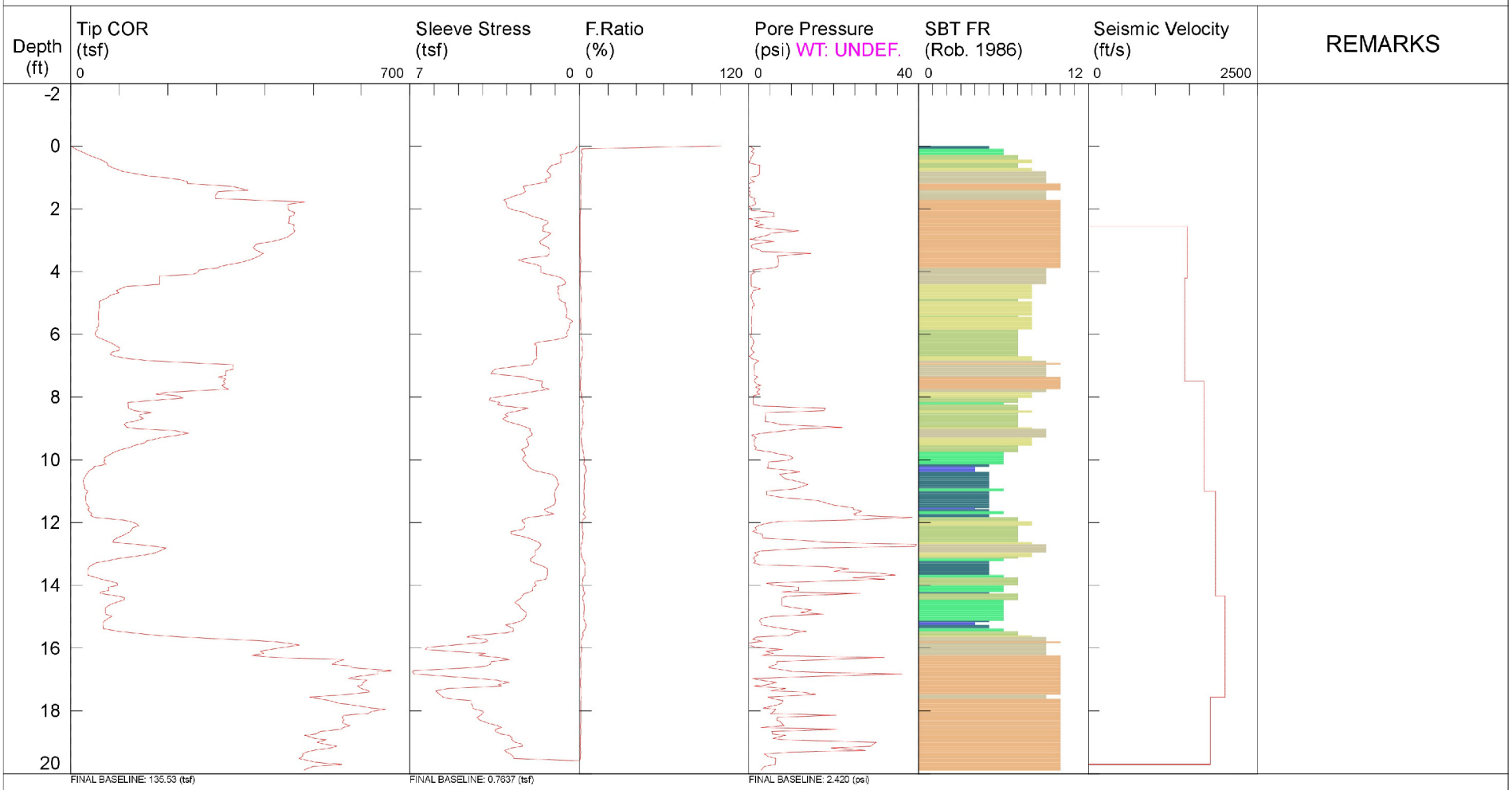
FIGURE 15

SOUNDING

ACache Corp.
Engineering a Firm Foundation

TOTAL DEPTH: 19.899 ft
SITE: CPT-01
SOUNDING
COMPANY: ACache Corp.
FILENAME: CPTS-01.dat

PROBE ID: 4444.190XX
TEST ID: 24-08-29-01
PROJECT: Hyde Park Elementary
LOCATION: Hyde Park City, Utah



NOTES:: Example of notes

1 Sensitive fine grained
2 Organic material
3 Clays
4 Silty clay to clay
5 Clayey silt to silty clay
6 Sandy silt to clayey silt
7 Silty sand to sandy silt
8 sand to silty sand
9 Sand
10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

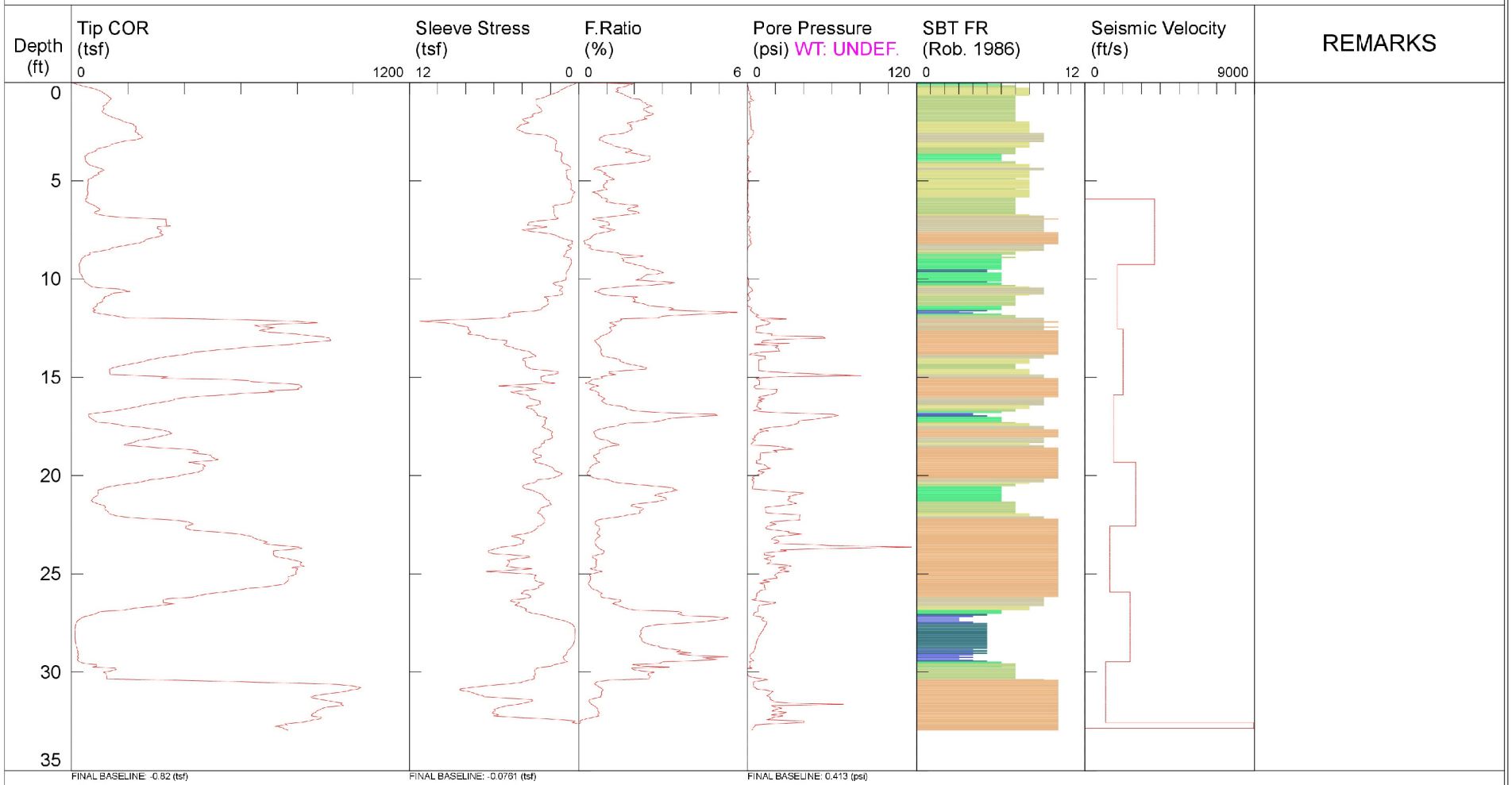
FIGURE 16

SOUNDING

ACache Corp.
Engineering a Firm Foundation

TOTAL DEPTH: 32.944 ft
SITE: CPT-02
SOUNDING
COMPANY: ACache Corp.
FILENAME: CPTS-02.dat

PROBE ID: 4444.190XX
TEST ID: 24-08-29-02
PROJECT: Hyde Park Elementary
LOCATION: Hyde Park City, Utah



NOTES:: Example of notes

1 Sensitive fine grained
2 Organic material
3 Clays
4 Silty clay to clay
5 Clayey silt to silty clay
6 Sandy silt to clayey silt
7 Silty sand to sandy silt
8 sand to silty sand
9 Sand
10 Gravelly sand to sand
11 Very stiff fine grained **
12 Sand to clayey sand **

*SBT: Robertson 1986; **Overconsolidated or Cemented; *SBT/SPT CORRELATION: UBC-1983

FIGURE 17

SECTION 31 1000

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Removing trees and other vegetation.
   2. Clearing and grubbing.
   3. Topsoil stripping.
   4. Removing above-grade site improvements.
   5. Disconnecting, capping or sealing, and removing site utilities.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
   2. Division 31 Section "Earthwork" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

A. Materials indicated to be stockpiled or to remain are the Owner's property. Cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

A. Photographs, DVD or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings according to Division 1 Section "Closeout Procedures."
   1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing indicated removal and/or access on property adjoining Owner's property will be obtained by Owner before award of Contract.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Notification: Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Locate and clearly flag trees and vegetation to remain or to be relocated.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
   2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
   1. Cover exposed roots with burlap and water regularly.
   2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
   3. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.
   1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange to shut off indicated utilities with utility companies.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, asphalt & concrete paving, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
   4. Use only hand methods for grubbing within drip line of remaining trees.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding 8-inch (200-mm) loose depth, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod, grass, asphalt and concrete paving before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
   2. Do not stockpile topsoil within drip line of remaining trees.
   3. Dispose of excess topsoil as specified for waste material disposal.
   4. Stockpile surplus topsoil and allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 1000

SECTION 31 2200

SITE EXCAVATION AND ROUGH GRADING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Definitions:
   1. Unsuitable material: Debris and/or soil material judged unsuitable by Engineer for support of slabs or other site improvements.
   2. Engineer: Soils Engineer employed by Owner, empowered to conduct inspections and make approvals.

1.2 QUALITY ASSURANCE

A. Compaction density test:
   1. Modified Proctor, ASTM-D 1557.

B. Layout work by Surveyor or Civil Engineer registered in the State of Utah. Identify benchmark to be used in establishing grades.

C. Owner will hire an independent soils laboratory to conduct in place moisture and density tests.

D. Tolerances of sub-grade:
   1. Unsurfaced areas: Plus/minus 0.20 FT from required elevations.
   2. Paved areas: Plus/minus 0.10 FT from required elevations.

1.3 JOB CONDITIONS

A. Protect existing facilities, utilities (overhead and underground), sidewalks, pavement.
   1. Repair damaged items.
   2. Notify Owner and make emergency repair as directed.

B. Protect graded areas against erosion.
   1. Re-establish grade where settlement or washing occurs at no extra cost.

PART 2 -PRODUCTS

2.1 MATERIALS

A. Fill materials:
   1. Reasonably free of roots, organic material, trash, frozen matter, and stones larger than 6 IN.
   2. Add water to dry material, as required.
   3. Allow wet material to dry, as required.
   4. Fill can only be obtained on site where removed from excavating and grading.
   5. Provide additional off-site borrow or fill as required.

B. Surplus material:

   1. Remove from site.

PART 3 -EXECUTION

3.1 PREPARATION

A. Layout units, structures, piping, roads, parking areas and walks and establish their elevations.

B. Perform other layout work required.

C. Preparation for embankments and fills:
   1. Remove topsoil over areas to be cut and filled that was not previously removed by stripping and grubbing.
   2. Before fill is started, scarify to a minimum depth of 6 IN under new roads, parking lots, or streets.
   3. Bring to optimum moisture content.
   4. Compact to a minimum 95 percent.
   5. In areas where existing ground surface is steeper than one vertical to four horizontal, bench surface in order to spread fill horizontally so that fill material will bond with existing surface.

3.2 GENERAL

A. Excavate and grade materials to design elevations.

B. Excavate and grade site to subgrades of paved and unpaved areas as indicated.

C. Excavate for miscellaneous footings, slabs, walks and other structures.

D. Cut and fill as required to bring existing grades to rough grades.

E. Furnish and place additional approved material required to bring subgrade to proper line and grade.

F. During construction, shape and drain embankments and excavation.

G. Maintain ditches and drains to provide drainage.

H. Provide pumping if required.

I. Remove unsuitable materials which cannot be compacted as specified and replace with suitable material.
   1. Dispose material on site as directed.
   2. Dispose material off site as directed.

J. Remove materials unsuitable to receive fill and replace with suitable material.

3.3 CONSTRUCTION OF EMBANKMENTS AND FILLS

A. Construct embankments and fills to lines and grades.

B. Make completed fill correspond to shape of typical cross section or contour indicated regardless of method used to indicate shape, size, and extent of line and grade of work.

C. Insure that cobbles larger than 4 IN, are not placed in upper 6 IN of fill or embankment.

D. Place material in lifts, maximum 8 IN loose thickness.

E. Place layers horizontally and compact each layer to specified density prior to placing additional fill.

F. Compact using suitable equipment.
   1. Control moisture to meet requirements of compaction.
   2. Place materials within 3 percent above to 3 percent below optimum moisture content.

G. Under roadways and parking areas and extending 1 FT beyond proposed curb line measured perpendicular from centerline, compact to 95 percent maximum dry density.

H. Under walk paving, compact to 95 percent maximum dry density.

I. For other embankments and fills not listed, compact to 90 percent of maximum dry density.

J. Under proposed building and structures, compact to density as specified in Section 31 23 00.

END OF SECTION 31 2200

SECTION 31 2300

EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches within building lines.
8. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.

B. Related Sections include the following:
1. Division 1 Section "Construction Facilities and Temporary Controls."
2. Division 31 Section "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.
1. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities: Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.5 PROJECT CONDITIONS

A. Site Information: A Geotechnical Investigation of this site has been prepared. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.
1. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

B. No additional monies for exporting or importing of soil.
1. As part of the Construction Documents, Owner may have provided Contractor with a Topographic Survey performed by manual or aerial means. Such Survey was prepared for project design purposes and is provided to the Contractor as a courtesy. It is expressly understood that such survey may not accurately reflect existing topographical conditions and typically will vary from actual conditions by a significant degree. It is the Contractor's responsibility to verify actual existing conditions by whatever means the Contractor deems appropriate. The Contractor shall be responsible for determining their own earthwork quantities and not rely on any estimate prepared by the Owner, its Agents or outside parties. The Contractor is responsible as part of its lump sum bid price for the project, for importing or exporting soils to achieve final sub-grades with suitable soils per the plans and specifications. No additional monies will be allowed beyond the Contractor's Lump Sum Bid Price for the project, for the exporting or importing of soils.

C. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
   1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
   2. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
   3. Notify Architect not less than seven (7) days in advance of proposed utility interruptions.
   4. Do not proceed with utility interruptions without Architect's written permission.
   5. Contact utility-locator service for area where Project is located before excavating.

D. Utilities to be removed: Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

E. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
   1. Operate warning lights as recommended by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 4 inches (100 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially well graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 70 percent passing a 3/4-inch (18-mm) sieve and not more than 25 percent passing a No. 200 (0.075-mm) sieve.

F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; conforming to the 1 inch gradation requirements of Section 301 of the UDOT Standard Specification for Road and Bridge Construction.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel,

crushed stone, and natural or crushed sand; ASTM D 2940; with at least 70 percent passing a 3/4-inch (18-mm) sieve and not more than 25 percent passing a No. 200 (0.075-mm) sieve.

H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

C. Trace Wire: Insulated 10 gage copper, suitable for direct bury.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.1 FT (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. If required to not disturb bottom of excavation, excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Excavation for Underground Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.1 FT (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Trench Excavation: Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
   2. Trench Clearance: Excavate trenches to uniform widths to provide a working

clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

3. Clearance: 12 inches (300 mm) on each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 TRENCH SUPPORT SYSTEMS

A. Trench support system shall be suitable for the soil structure, depth of cut, water content of soil, weather conditions, superimposed loads and vibration. Contractor may select one of the following methods of ensuring the safety of workers in the trench, as approved by the Utah State Industrial Commission or its safety inspectors:

1. Sloping the sides of the trench to the angle of repose at which the soil will remain safely at rest.
2. Shoring trench sides by placing sheeting, timber shores, trench jacks, bracing, piles, or other materials to resist pressures surrounding the excavation.
3. Using a movable trench box built-up of steel plates and heavy steel frame of sufficient strength to resist the pressures surrounding the excavation

3.9 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top

elevation. Lean concrete fill may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.13 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil material to final subgrade.

G. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.14 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

3.15 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 6 inches (150 mm) of existing subgrade and each layer of backfill or fill material at 95 percent. Compact to 98 percent for fills thicker than 6 feet deep.
   2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 95 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 90 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 0.2 FT (25 mm).
   2. Walks: Plus or minus 0.1 FT (25 mm).
   3. Pavements: Plus or minus 0.1 FT (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 0.1 FT (13 mm) when tested with a 10-foot (3-m) straightedge.

3.18 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course on prepared subgrade and as follows:
   1. Place base course material over subbase.
   2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
   3. Shape subbase and base to required crown elevations and cross-slope grades.
   4. When thickness of compacted subbase or base course is 6 inches (150 mm) or less, place materials in a single layer.
   5. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE

A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
   1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
   2. When compacted thickness of drainage course is 6 inches (150 mm) or less, place materials in a single layer.
   3. When compacted thickness of drainage course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall/Continuous Footing Backfill: At each compacted backfill layer, at least one test for each 15 linear feet or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 40 feet or less of trench length, but no fewer than two tests.
4. Spot Footings: Minimum of 1 compaction test for each lift for each spot footing.
5. Sidewalks, Curbs, Gutters, Pads: Minimum of 1 test for each lift for each 40 lineal feet or 1 test for every 1000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 2300

SECTION 31 2500

EROSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers the work required for erosion control during construction. Any local or State Agency requirements will be considered part of these specifications.

B. Obtain the National Pollution Discharge Elimination System (NPDES) Permit for storm water discharge associated with construction activity.

C. Obtain a UPDES Storm Water General Permit for Construction Activities (Permit #UTR100000) or an alternate individual permit. Applications are available online at www.waterquality.utah.gov/UPDES/stormwater.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. Silt fence shall be a woven fabric that meets the following criteria:

Property	Unit	Test Method	Values
Grab Strength	lbs	ASTMD-4632	90 min
Grab Elongation	%	ASTMD-4632	40 max
Water Flow Rate	gal/min/ft2	ASTMD-4491	15 min
Ultraviolet Stability	%	ASTMD-4355	70% min

PART 3 - EXECUTION

3.1 EXECUTION

A. Silt fence shall be placed in accordance with plans and details. The placement of silt fence and/or bales shall consider drainage paths and intercept drainage prior to leaving the site or entering a storm sewer system. Removal of silt and replacement of silt fence and/or bales shall be on going through the duration of the project to maintain an effective silt removing barrier.

B. Sediment Basin and/or sinks shall be constructed to dimensions shown on the plans. The basins and/or sinks shall be cleaned as required to maintain specified size and depth.

C. All temporary grading of drainage channels, slopes or fills shall be in accordance with Division 31 Section "Earthwork".

END OF SECTION 31 2500

SECTION 32 1216

ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

B. Related Requirements:

1. **Section 024119 "Selective Demolition"** for demolition and removal of existing asphalt pavement.
2. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
4. Section 321400 "Unit Paving" for bituminous setting bed for pavers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at site.

B. Review SECTION 013100 "Project Management and Coordination." for conference participants.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
3. Job-Mix Designs: For each job mix proposed for the Work.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [**manufacturer**] [**and**] [**testing agency**].

B. Material Certificates: For each paving material. [**Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.**]

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: [**A paving-mix manufacturer approved by engineer**].

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of MILLVILLE CITY STANDARDS and UDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: [**ASTM D 1073**] [**or**] [**AASHTO M 29**], sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: [**ASTM D 242/D 242M**] [**or**] [**AASHTO M 17**], rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, [**PG 58-28**]

B. Asphalt Cement: [**ASTM D 3381/D 3381M for viscosity-graded material**] [**ASTM D 946/D 946M for penetration-graded material**].

C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, [**MC-30 or MC-70**] [**MC-250**].

D. Emulsified Asphalt Prime Coat: [**ASTM D 977**] [**or**] [**AASHTO M 140**] emulsified asphalt, or [**ASTM D 2397**] [**or**] [**AASHTO M 208**] cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Tack Coat: [**ASTM D 977**] [**or**] [**AASHTO M 140**] emulsified asphalt, or [**ASTM D 2397**] [**or**] [**AASHTO M 208**] cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Fog Seal: [**ASTM D 977**] [**or**] [**AASHTO M 140**] emulsified asphalt, or [**ASTM D 2397**] [**or**] [**AASHTO M 208**] cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Water: Potable.

H. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled [**tires**] [**asphalt shingles**] [**or**] [**glass**] from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

C. Sand: [**ASTM D 1073**] [**or**] [**AASHTO M 29**], Grade No. 2 or No. 3.

D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

E. Joint Sealant: [**ASTM D 6690**] [**or**] [**AASHTO M 324**], [**Type I**] [**Type II or III**] [**Type IV**], hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**10**] percent or more than [**15**] percent by weight.

1. Surface Course Limit: Recycled content no more than [**10**] percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes [**approved by authorities having jurisdiction**] [**; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types";**] and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: 3/4"
3. Surface Course: 1/2"

C. Emulsified-Asphalt Slurry: ASTM D 3910, [**Type 1**] [**Type 2**] [**Type 3**].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction**, [repeating proof-rolling in direction perpendicular to first direction**]. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of [**2 inches**]
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of [**1/4 inch**]

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 PAVING GEOTEXTILE INSTALLATION

A. Apply [**tack coat**] [**asphalt binder**] [**asphalt cement**] uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd.

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.7 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches
3. Offset transverse joints, in successive courses, a minimum of 24 inches
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints [**using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."**] Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
5. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to [**ASTM D 6927**] [**or**] [**AASHTO T 245**], but not less than 94 percent or greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 ASPHALT CURBS

A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F

1. Asphalt Mix: Same as pavement surface-course mix.

B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.11 ASPHALT TRAFFIC-CALMING DEVICES

A. Construct hot-mix asphalt speed [**bumps**] [**humps**] [**cushions**] [**and**] [**tables**] over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F

1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
2. Asphalt Mix: Same as pavement surface-course mix.
3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch from top of pavement to a clean, rough profile.

B. Place and compact hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.12 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch
2. Surface Course: Plus 1/4 inch no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: [**1/4 inch**]
2. Surface Course: [**1/8 inch**]
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.13 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to [**ASTM D 979**] [**or**] [**AASHTO T 168**].

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.15 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 32 1216

SECTION 32 1313-USU MIX

CAST IN PLACE EXTERIOR CONCRETE

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY:

A. Exterior concrete shall be defined as all concrete flatwork (sidewalks, curb, gutter, driveways, paving, landings, aprons, stairs, etc.) that is exposed to exterior freeze/thaw conditions and deicer use. Exterior site walls, retaining walls and substrate slabs shall refer to USU Specification Section 033053 Miscellaneous Cast In Place Concrete.

1.03 PRE-INSTALLATION CONFERENCE:

A. General Contractor, Sub-Contractor(s), and Ready-Mix supplier shall participate in a pre-installation conference with USU Facilities PD&C to coordinate with users and review the installation schedule. The following items shall also be reviewed:

1. Mix design requirements, including admixtures
2. Requirements for preparation of subgrade
3. Placement, finishing and curing of concrete
4. Hot and cold weather requirements
5. Jointing requirements and joint layout
6. Safety issues

1.04 SUBMITTALS:

A. Contractor shall submit concrete mix design(s), certifications and all other required product spec sheets to engineer for review prior to any construction. Allow one (1) week for engineering review.

B. No concrete shall be poured without prior written approval of all submittals.

1.05 AGGREGATE:

A. General:

1. Aggregates for all concrete shall come from a quarry that is DOT approved and meets or exceeds durability Class I aggregate. The quarry shall submit a letter to USU FPD&C that
2. Certifies that all aggregate complies with DOT requirements for durability. Aggregate not meeting DOT durability requirements shall not be used.

B. Cleanliness:

1. The concrete supplier shall submit written certification by an independent testing agency

2. Demonstrating that aggregates supplied meet this requirement.

   a. All fine aggregates shall have a Sand Equivalent (SE) value of not less than 80 according to ASTM D2419 and/or AASHTO T176.

   b. All coarse aggregates shall have a Cleanliness Value (CV) of not less than 80 according to California Department of Transportation Test 227.

C. Coarse aggregate:

1. 1” minus and well-graded crushed aggregate meeting ASTM C33. Aggregate shall be free of deleterious coatings and other materials and/or aggregate types causing pop outs,

2. Discoloration, staining, alkaline reactions or other defects within the concrete. The concrete supplier shall submit written certification by and independent testing source of aggregate testing and soundness in accordance with ASTM C33 with all concrete mix designs.

D. Fine aggregate:

1. Natural sand or blend of natural sand and crushed sand meeting ASTM C33. Crushed sand shall be less than 50% of the total sand by dry weight.

1.06 CEMENT:

A. Portland Type I or Type II (Do not use Type I-A or II-A).

1.07 POZZOLAN:

A. No pozzolans (e.g., fly ash, silica fume, slag, etc.) shall be used in the concrete mix without the express written consent of the engineer.

1.08 WATERPROOF CONCRETE ADMIXTURE:

A. Product generic name: Water-based waterproof concrete admixture.

B. Product name: Hycrete W502, as manufactured by Hycrete, Inc., 462 Barell Avenue, Carlstadt, New Jersey, 07072, telephone (201) 386-8110. See manufacturer’s website www.hycrete.com for further information.

C. Comply with the manufacturer’s instructions and recommendations.

1.09 REINFORCING:

A. ‘RSC15’ polyvinyl alcohol (PVA) fibers as manufactured by Nycon at a dosage rate not less than two (2) lbs. per cubic yard or approved equal.

B. See manufacturer’s web site http://www.nycon.com for further info.

1.10 COMPRESSIVE STRENGTH:

A. 4500 psi, minimum at twenty-eight (28) days, using a minimum 6.5-bag mix.

1.11 WATER/CEMENT RATIO:

A. 0.44 maximum (total cementitious materials)

B. No additional water shall be permitted either in transit or on site.

1.12 AIR ENTRAINMENT:

A. 6.5% (+/- 1.5%), using an air-entraining admixture conforming to ASTM C260.

1.13 SLUMP:

A. 3” (+/- 1”) OR 3”-6” with the addition of a water reducer conforming to ASTM C494 (Type A).

1.14 SURFACE PREPARATION:

A. Remove all water, debris, dirt clods, etc., from space where concrete is to be placed.

B. Unless noted otherwise, all exterior concrete flatwork shall be installed with six inches (6”) minimum, of washed, crushed gravel beneath it (1” minus).

C. Gravel shall be well compacted and pre-wetted as per ACI standards prior to concrete installation.

1.15 SPECIAL TECHNIQUES:

A. Cold Weather Concreting Procedures:

1. General Requirements:

a. Although the schedules of building projects may necessitate it, the Installation of exterior concrete flatwork is NOT recommended before April 1st or after October 1st, due to Cache Valley climate.

b. Materials and equipment required for heating and protection of concrete shall be

2. Approved and available at project site before beginning cold weather concreting.

a. Forms, reinforcement, metallic embedments, and fillers shall be free from snow, ice, and frost. Surfaces that will be in contact with newly placed concrete, including sub-grade materials, shall be 35 deg F (2 deg C) minimum at time of concrete placement.

b. Thaw sub-grade 6 inches (150 mm) deep minimum before beginning concrete placement. If necessary, re-compact all thawed material.

a. Use no frozen materials or materials containing ice.

b. Requirements When Average twenty-four (24) Hour Temperature, midnight to midnight, Is Below 40 deg F (4 deg C):

c. Temperature of concrete as placed and maintained shall be 55 deg F (13 deg C) Minimum and 75 deg F (27 deg C) maximum.

d. Heat concrete for seventy-two (72) hours minimum after placing if regular cement is used; for 48 hours if high early strength cement is used; or longer

e. If determined necessary by USU FPD&C.: During this period, maintain concrete surface temperature between 55 and 75 deg F (13 and 27 deg C).

f. Vent flue gases from combustion heating units to outside of enclosure to prevent carbonation of concrete surface.

g. Prevent concrete from drying during heating period. Maintain housing, insulation, covering, and other protection twenty-four (24) hours after heat is discontinued.

h. After heating period, if temperature falls below 32 deg F (0 deg C), protect concrete from freezing until strength of 2000 psi minimum is achieved.

i. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi minimum is achieved.

4. Requirements When Average twenty-four (24) Hour Temperature, midnight to midnight, Is Above 40 deg F (4 deg C), but when temperature falls below 32 deg F (0 deg C):

a. Protect concrete from freezing for seventy-two (72) hours after placing, or until strength of 2000 psi is achieved, whichever is longer.

b. Protect flatwork exposed to melting snow or rain during day and freezing during night from freezing until strength of 3500 psi minimum is achieved.

B. Hot Weather Concreting Procedures:

1. Maximum concrete temperature allowed is 90 deg F (32 deg C) in hot weather.

2. Cool aggregate and subgrades by sprinkling with water.

3. Avoid cement over 140 deg F (60 deg C).

4. Use cold mixing water or ice.

5. Use fog spray or evaporation retardant to lessen rapid evaporation from concrete surface.

1.16 FINISHING OF EXTERIOR CONCRETE:

A. All concrete sidewalks and other flatwork shall have a cross-slope of not greater than 2% but not less than 0.5% toward the curb or street to provide positive drainage.

B. Use of steel floats/trowels, power screeds and vibrators for the finishing of exterior, air-entrained concrete is not permitted and shall be cause for rejection of any or all work.

C. Bull floating and/or darbying shall follow promptly after initial screening using magnesium tools only.

D. No finishing operations shall be performed with bleed water present on the surface of the concrete. Any dusting of cement powder onto the surface to absorb bleed water or the working of bleed water back into the surface of the concrete is not permitted.

E. All concrete slabs shall be edged according to current ACI standards.

F. Sprinkling of water on the surface of the concrete to re-temper it during any finishing process is not permitted.

G. Trowelling of concrete shall be limited to a single, light pass before final finish using a magnesium trowel only.

H. All concrete shall have slip resistant finishes. The standard finish, unless noted otherwise, shall be coarse broomed finish - Finishes shall be applied to the surface before the concrete has thoroughly hardened but yet sufficiently hardened to retain the scoring impressions.

1.17 CONCRETE CURING:

A. Curing procedures shall begin immediately after the final finishing process is complete and the surface sheen is gone.

B. Contractor shall provide proper curing of concrete by employing initial and final curing methods as indicated in ACI 308R-01.

C. Final curing shall be achieved by providing and/or installing the following:

1. Moist curing methods that maintain a continuously wet surface such as ponding, sprinkling, plastic sheeting, or wet burlap sheets for a minimum period of 7 days. Moist curing is the curing method of choice for all exterior concrete on USU campus.

2. As an alternate, liquid membrane-forming curing compound(s) conforming to ASTM C-309 or ASTM C-1315, applied according to manufacturer's recommendations and with the following additional requirements:

a. Curing agent shall be applied in two (2) applications at right angles to each other to ensure uniform and complete coverage.

3. Curing agent shall contain a fugitive dye or white pigmentation which allows an inspector to see that the agent has been adequately applied.

4. Contractor shall provide evidence of the amount of curing agent used for the project.

5. The use of sprayed curing compounds is NOT recommended before April 1st or after October 1st due to Cache Valley climate.

D. Contractor shall make every effort to allow concrete to air dry for at least 30 days after the curing process is complete before exposing it to freeze/thaw conditions.

1.18 JOINTS:

A. All exterior concrete shall have expansion and control joints installed according to current ACI Standards.

B. Expansion Joints:

1. Joint material shall be Re-Flex rubber expansion joint material as manufactured by the J.D. Russell Company or approved equal. See manufacturer's website www.jdrussellco.com/reflex.html for more information.

2. Joints shall be sealed using a self-leveling sealer installed as per manufacturer's recommendations. Approved sealers are: Sonolastic SL1, Novalink SL or approved equal.

C. Control Joints:

1. Joints shall be installed using one of two methods:

a. Saw cutting using a beveled blade that provides a 3/8” beveled profile. Straight, unbeveled saw cuts are not allowed. Contractors are encouraged to use this method. See www.cardinalsaws.com for further information.

b. Tooled joints that provide a maximum 3/8” radius (rounded) profile.

1.19 COLORED CONCRETE:

A. N/A

1.20 FIELD TESTS AND INSPECTIONS:

A. Testing Agency shall provide testing and inspection for concrete as per ASTM C1077.

B. Testing Agency will sample and test for quality control during placement of concrete as directed by USU FPD&C.

C. Testing and inspections, if performed, will include the following:

1. Periodic inspection verifying use of required design mix.

2. Inspection at time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine temperature of concrete.

3. Inspection of concrete placement for proper application techniques.

4. Periodic inspection of curing materials and techniques.

5. Periodic inspection of formwork for configuration, location, and dimensions of concrete member being formed.

6. Slope of concrete members.

D. Testing Agency will sample and test during placement of concrete as directed by USU FPD&C and may include the following:

1. Sampling Fresh Concrete: ASTM C172, except as modified for slump to comply with ASTM C94:

a. Slump: ASTM C143. Test each time a set of compressive test specimens are made.

b. Air Content: ASTM C173. Volumetric method for normal weight concrete each time a set of compression test specimens is made.

c. Concrete Temperature: Test each time a set of compressive test specimens is made.

d. Unit Weight: ASTM C567. Test each time a set of compressive test specimens is made.

E. Compression Test Specimens: ASTM C31. One (1) set of four (4) standard cylinders for each compressive strength test, unless otherwise directed.

1. Compressive Strength Tests: ASTM C39:

a. Obtain one (1) composite sample for each day's pour of each concrete mixture exceeding 5 cu. Yd., but less than 50 cu. Yd, plus one (1) set for each additional 50 cu. Yd. or fraction thereof.

b. One (1) specimen tested at seven (7) days, two (2) specimens tested at twenty-eight (28) Days, and one (1) specimen retained in reserve for later testing if required.

c. If strength of field-cured cylinders is less than eighty-five (85) percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing in-place concrete.

d. Strength level of concrete will be considered satisfactory if averages of sets of three (3) Consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

1.21 PROTECTION:

A. Protect concrete that has not received its initial set from pedestrian traffic and from precipitation to avoid excess water in the mix and an unsatisfactory surface finish.

B. Do not allow materials resulting from construction activities, which will affect concrete, to come in contact with concrete slabs.

1.22 WARRANTY:

A. Contractor shall provide a two-year written guarantee of concrete materials and workmanship commencing on the date of substantial completion to promptly remove and/or repair all defective concrete (i.e., pitting, scaling, flaking, cracking, honeycombing, etc.).

END OF SECTION 32 1313

SECTION 32 1722

PAINTED PLAYGROUND MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools, and services required to fully complete all Painted Playground Marking work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Playground markings.
C. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Division 32 - Asphalt and/or Concrete Paving.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Paint: 2 containers, 1 gallon size, of each type and color.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.05 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MATERIALS

A. Marking Paint: Basis of Design:
   1. Hotline Fast Dry Latex Marking Paint by Sherwin Williams
   2. colors as selected by Architect.
   3. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
C. Clean surfaces thoroughly prior to installation.
    1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
    2. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement, by scraping, wire brushing, sandblasting, mechanical abrasion, or approved chemicals.
D. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
E. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.

3.03 INSTALLATION

A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
D. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
E. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the drawings true, sharp edges and ends.
    1. Apply paint in one coat only.
    2. Wet Film Thickness: 0.015 inch, minimum.
    3. Length Tolerance: Plus or minus 3 inches.
    4. Width Tolerance: Plus or minus 1/8 inch.
F. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
F. Replace removed markings at no additional cost to Owner.

END OF SECTION 32 1722

SECTION 32 1723

PAVEMENT MARKINGS

PART 1 -GENERAL

1.1 SUBMITTALS

A. Project information:
   1. Manufacturer of listed products.

1.2 JOB CONDITIONS

A. Do not paint when surface is wet, during wet or damp weather, or when temperature is below 40 deg F.

B. Do not paint or install markers when surface is wet, during wet or damp weather, or when temperature is below 40 deg F.

C. Painting Equipment:
   1 Self-contained, self-propelled striping machine.
   2 Capable of painting line 4 IN wide with spray nozzle.
   3 Paint kept in constant agitation and under pressure.

PART 2 -PRODUCTS

2.1 MATERIALS

A. Acceptable manufacturers:
   1. Paint:
      a. Base:
         1) ICI Paints.
      b. Optional:
         1) Sherwin-Williams.

   2. Other manufacturers desiring approval comply with Section 00 26 00.

2.2 PAINT

A. Non-Reflective Paint:
   1 Description: Non-reflective paint conforming to F.S.TT-P-1952B.
   2 Base Product: “Traffic Paint, Water Reducible Acrylic,” Series 4800 by ICI Paints.

Item	Color	Reflective / Non-Reflective
Parking Stripping	Yellow	Non-Reflective
Traffic Arrows	White	Non-Reflective
Pavement Lettering	White	Non-Reflective
Helipads	Red / White	Non-Reflective
Accessible Symbols	Blue	Non-Reflective
Fire Lanes	Red	Non-Reflective
Paint-out of existing items	Black	Non-Reflective

PART 3 -EXECUTION

3.1 PREPARATION OF SURFACE

A. Do not paint until a minimum of 5 days has elapsed from time surface is completed or cured.

1. A longer period of time may be required if directed by Architect.

B. Thoroughly clean surfaces to receive striping or marking.

C. Assure surface is dry.

3.2 PAINTING

A. Mark and stripe in accordance with applicable drawings with approved striping machine.

B. Width of painted lines: 4 IN.

C. Provide painted accessible symbols in handicapped parking stalls.

D. Use a guide to form markings true to line and width.

E. Keep paints thoroughly stirred and of uniform consistency during application.

F. Do not thin in excess of manufacturer's recommendations.

G. Use rates of application sufficient to produce complete coverage without voids or thin spots.
1. Minimum Dry Film Thickness: 7mil.

H. Overpaint unsatisfactory markings as directed by Architect.

I. Protect marking from traffic until paint has dried to prevent tracking.

3.3 CLEANING UP

A. Place rags and waste which might constitute a fire hazard in metal containers or destroy at end of each work day.

B. Remove containers from site.

C. Remove paint spots or stains on adjacent surfaces.

D. Leave job clean and acceptable to Architect.

END OF SECTION 32 1723

SECTION 32 3113

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Furnish all labor, materials, equipment, tools and services required to fully complete all Chain Link Fence and Gate work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
B. Posts, rails, and frames.
C. Standard fence framework, fabric, and accessories.
   1. 72 inches (1.8 m) high.
D. Wire fabric.
E. Manual gates with related hardware.
F. Accessories.
G. Do not include sales tax, refer to Section 00 1115 - Advertisement for Prequalification of Bidders.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete anchorage for posts.
B. Section 11 6833 - Athletic Field Equipment: Fence top and rail padding and guard caps.
C. Section 32 3119 - Decorative Metal Fences and Gates.

1.03 REFERENCE STANDARDS

A. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire; 2013.
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
D. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).
E. ASTM A428/A428M - Standard Test Method for Weight (Mass) of Coating on Aluminum-Coated Iron or Steel Articles; 2010 (Reapproved 2014).
F. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; 2011 (Reapproved 2022).
G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
H. ASTM A 702 - Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought; 2006.
I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.
K. ASTM F2000 - Standard Guide for Fences for Baseball and Softball Fields; 2010.
L. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2014a.
M. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric; 2017 (Reapproved 2022).
N. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2017a.

O. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2016.
P. ASTM F1665 - Standard Specification for Poly(Vinyl Chloride)(PVC) and Other Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence; 2008 (Reapproved 2013).
Q. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.
R. CLFMI CLF-PM0610 - Product Manual; 2017.
S. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.
D. Samples: Submit two samples of fence fabric,slat infill, 12 inch by 12 inch in size illustrating construction andcolored finish.
E. Manufacturer's Installation Instructions: Indicate installation requirements, post foundation, and anchor bolt templates.
F. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property linesand easements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 GUARANTEE

A. The Contractor shall guarantee this work for a period of One (1) year from date of Substantial Completion. Guarantee shall be on form included in Section 01 7800.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chain Link Fences and Gates:
    1. Master-Halco, Inc.: www.masterhalco.com.
    2. Merchants Metals: www.merchantsmetals.com
    3. South Western Wire: www.southwesternwire.com
    4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 INSTALLERS

A. Western Fence Co.: www.westernfenceco.com.
B. United Fence Co.: www.unitedfenceco.com.
C. Mountain States Fence Co.: www.msfence.com.
D. American Fence Co.: www.americanfence.com.
E. Allied Fence Co.: www.alliedfence.com.
F. Vinyl Industries: www.Vinyli.com.
G. Substitutions: See Section 01 6000 - Product Requirements.

2.03 MATERIALS

A. Posts, Rails, and Frames:

1. ASTM F 1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction.
    a. Minimum yield strength of 30 ksi (205 MPa) at Standard Fence, Sideline Fence, and Dugout Fence locations.

B. ASTM A1011/A1011M Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating conforming to ASTM F1043 and ASTM F1083.
C. Line Posts: Type I round.
D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round.
E. Conform to CLFMI CLF-PM0610.
F. Wire Fabric:
    1. Wire Fabric: ASTM A 392 zinc coated GBW steel chain link fabric.
        a. At Standard Fence, Sideline Fence, Backstop Fence, and Dugout Fence locations.
G. Conform to CLFMI CLF-PM0610.
H. Brace and Tension (Stretcher Bar) Bands: ASTM F626 galvanized pressed steel.
I. Tension (Stretcher) Bars: ASTM F626 galvanized steel.
J. Truss Rod: ASTM F626 galvanized steel.
K. Concrete - Ready-mixed, complying with ASTM C 94/C 94M; normal Portland cement; 3000 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.

2.04 COMPONENTS

A. Line Posts:
    1. 36 to 96 inch (914 to 2438 mm) high fence: 2.38 inch (60 mm) diameter.
B. Corner and Terminal Posts:
    1. 36 to 72 inch (914 to 1829 mm) high fence: 3.5 inch (89 mm).
C. Gate Posts:
    1. Gate height up to and including 72 inches (1829 mm):
        a. Gate width up to 48 inches (1219 mm): 2.38 (60 mm) diameter.
    2. Gate height from 72 to 144 inches (1829 to 3658 mm):
        a. Gate width from 72 to 144 inches (1829 to 3658 mm): 4 inch (100 mm) diameter.
D. Top, Center, Bottom, and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
E. Gate Frame: 1.66 inch diameter for welded fabrication (man type) and 2.38 inch (60 mm) diameter for welded fabrication (traffic type).
F. Wire Fabric: 2 inch diamond mesh interwoven wire, 9 gage, 0.1144 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
G. Brace and Tension (Stretcher Bar) Bands: 12 gage (2.67mm) pressed steel by 3/4 inch (19mm) formed to a minimum 300 degree profile curvature for post attachment. Secure bands using minimum 5/16 inch (7.94 mm) galvanized carriage bolt and nut.
H. Tension (Stretcher) Bars: One piece length equal to 2 inches (50 mm) less than full height of fabric with a minimum cross-section of 3/16 x 3/4 inch (4.76 x 19 mm). Provide tension (stretcher) bars where chain link fabric is secured to the terminal post.
I. Truss Rod Assembly: 5/16 inch (7.9 mm) diameter truss rod with pressed steel tightener.
J. Tie Wire: 9 gage (3.76 mm) galvanized steel wire for attachment of fabric to line posts and rails. Tie wire per ASTM F 626.

2.05 MANUAL GATES AND RELATED HARDWARE

A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.
C. Hinges: Finished to match fence components.
   1. Brackets: Round.
   2. Mounting: Center.
   3. Closing: Manual.

2.06 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
B. Fittings: Sleeves, bands, clips, rail ends, fasteners, fittings and angled connection fittings; galvanized steel per ASTM F 626.

2.07 FINISHES

A. Components (Other than Fabric) at Standard Fence, Sideline Fence, Backstop Fence and Dugout Fence Locations: Galvanized in accordance with ASTM A 123/A 123M, at 1.9 oz/sq ft.
B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
C. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 CHAIN LINK FRAMEWORK INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567 and manufacturer's instructions.
   1. ASTM F2000 for ballfield fences.
B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
C. Space line posts uniformly maximum 96 inches (2438 mm) on center.
D. Concrete Set Posts: Excavate holes in firm, undisturbed or compacted soil. Holes shall have diameter 4 times greater than outside dimension of post, and depths approximately 6 inches (152 mm) deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 inches (914 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts.
E. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
F. Bracing: Install horizontal brace and truss assembly at mid-height or above for fences 72 inches (1829 mm) and over at each fabric connection to the terminal post. The diagonal truss rod is installed at the point where the brace rail is attached to the terminal post and diagonally down to the bottom of the adjacent line post. Place the truss rod in tension by adjusting the turnbuckle.
G. Top Rail: Install in lengths of 21 feet (6400 mm). Connect ends with sleeves forming a rigid connection, allow for expansion and contraction.
H. Center Rails: Install mid rails between line posts and attach to post using rail end or line rail clamps. A center rail is required for fabric height 120 inches (3048 mm) and over.
I. Bottom Rails: Install bottom rails between posts and attach to post using rail end or line rail clamps.

3.02 CHAIN LINK FABRIC INSTALLATION

A. Install fabric on security side, pull fabric taut; thread the tension bar through fabric and attach to terminal posts with tension bands spaced maximum of 15 inches (381 mm) on center and attach so that fabric remains in tension after pulling force is released. Install fabric so that it is 2 inches (50 mm) +/- 1 inch (25 mm) above finish grade.
B. Secure fabric using wire ties to line posts at 15 inches (381 mm) on center and to rails and braces 24 inches (610 mm) on center, and to the tension wire using hog rings 24 inches (610 mm) on center. Tie wire shall be secured to the fabric by wrapping it two 360 degree turns around the chain link wire pickets. Cut off any excess wire and bend back so as not to protrude so as to avoid injury if a pedestrian may come in contact with the fence.

3.03 CHAIN LINK GATE INSTALLATION

A. Gate Framework: Fabricate chain link gates in accordance with ASTM F 900. Gate frame to be of welded construction. Weld areas to be protected with zinc-rich paint per ASTM A 780. The gate frame members are to be spaced no greater than 96 inches (2434 mm) apart horizontally or vertically.
B. Gate Fabric: Fabric to be stretched tightly and secured to vertical outer frame members using tension bar and tension bands spaced 12 inches (304.8 mm) on center and tied to the horizontal and interior members 12 inches (304.8 mm) on center using 9 gage galvanized steel ties.
C. Swing gates: Installation of swing gates and gate posts shall be per ASTM F 567. Direction of swing shall be as shown on drawings. Gates shall be hung plumb in the closed position with minimal space from grade to bottom of gate leaf. Double gate drop bar receiver shall be set in a minimum concrete footing 6 inch (152 mm) diameter by 24 inches (610 mm) deep. Gate leaf holdbacks shall be installed on all double gates and all gate leafs greater than 60 inches (1524 mm) in width.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Position: 1 inch.
C. Do not infringe on adjacent property lines.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4300 - Quality Assurance, for additional requirements.
B. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

END OF SECTION 32 3113

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SECTION 32 8423

UNDERGROUND SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.

B. Related Requirements:

Related Sections include the following:
   1. 32 8423 Underground Sprinklers
   2. 32 9001 Common Planting
   3. 32 9113 Soil Preparation
   4. 32 9120 Topsoil Placement & Grading
   5. 32 9223 Sodding
   6. 32 9300 Plants

1.2 REFERENCES

A. Definitions:
   1. Dielectric Fittings: Special type of fitting used between dissimilar metals to prevent galvanic action from causing corrosion failure.
   2. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
   3. Non-Pressure Lateral Line: Downstream from electric control valves to pop-up spray heads and drip valve assemblies to emitters. Piping or tubing is under pressure during flow. In areas where potable or secondary water are used, pressure supply line shall be white. In areas where non-potable or reclaimed water are used, pressure supply line shall be purple.
   4. Peak Flow: Maximum required flow for given month based on six (6) day week, nine (9) hour day watering window to be used for irrigation system design and to be used in hydraulic analysis.
   5. Point of Connection: Location where new irrigation joins with existing irrigation system.
   6. Pressure Supply Line: Downstream from point of connection to electric control valves. Piping is under water-distribution-system pressure when activated by master valve or hydrometer. In areas where potable or secondary water are used, pressure supply line shall be white. In areas where non-potable or reclaimed water are used, pressure supply line shall be purple.
   7. Static Water Pressure: Pressure at point of connection when system is not operable.
   8. Working Pressure: Pressure at point of connection when system is operable.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Provide Coordination for required tests and inspections as described under Field Quality Control in Part 3 EXECUTION for the following:
      a. Manufacturer's Field Service: Provide necessary manufacturer's field service.
      b. Pressure Test: In the presence of Landscape Architect provide a pressure test.
      c. Walk Through for Substantial Completion: In the presence of Landscape Architect, plan and provide walk through for Substantial Completion after Contractor has completed all Work.
      d. Final Walk Through: In the presence of the Landscape Architect, plan and provide final walk through after Contractor has completed all work listed on substantial completion walk through punch list provided by Landscape Architect.

B. Pre-Installation Conference:
   1. Schedule pre-installation conference before irrigation system installation begins.
   2. Review the following as specific agenda items during the pre-installation conference:
      a. Landscape architect or designated landscape consultant shall demonstrate or describe method to be used to maintain head spacing from concrete and to stabilize heads.
      b. Within the field yard, provide one installed example of each type of irrigation detail for review and approval by the Landscape Architect and owner prior to beginning work in the field.

C. Sequencing:
   1. Install sleeves before installation of cast-in-place concrete site elements and paving.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's cut sheets for each element of system.
      b. Parts list for operating elements of system.

B. Informational Submittals:
   1. Certificates:
      a. Acceptance certificate of irrigation system.
         1) Upon acceptance of irrigation system, reviewer will provide signed acceptance certificate.
         2) Certificate will include name and signature of reviewer, reviewer's company, date of review, and reviewer's telephone number.
   2. Test And Evaluation Reports:
      a. Results of mainline service pressure test before beginning work on system should be submitted as a report following the testing and before burial of the mainline.
      b. Provide the following from Main Line Irrigation test and observation:
         1) Record and submit documentation of Irrigation Main Line tests, issues, and measure taking to correct problems.
   3. Manufacturer Instructions:
      a. Manufacturer's printed literature on operation and maintenance of operating elements of system.
      b. Instruction Manual:
         1) Includes complete directions for system operation and maintenance, including winterizing, controller program worksheet and annual service and scheduling calendar based on local site-specific conditions.

4. Qualification Submittals:
    a. Irrigation Installer:
        1) Provide documentation of the following:
            a) Firm experience in irrigation projects (minimum of five years)
            b) Financial stability.
            c) Comply with specifications and contract documents.

C. Closeout Submittals:
1. Substantial Completion Walkthrough:
    a. Punch List items complete
    b. 2 copies of irrigation as-built drawings
    c. Operations And Maintenance Data – one copy of each to be provided to Owner:
        1) Instruction Manual.
        2) Manufacturer's printed literature.
        3) Manufacturer's cut sheets for each element of system.
        4) Manufacturer’s parts list.
        5) Main Line Irrigation observation report.
        6) Freezing prevention instructions.
        7) Controller Program Schedule

    d. Record Documentation:
        1) Certificates:
            a) Acceptance certificate of irrigation system.
        2) Testing and Inspection Reports:
            a) Mainline Pressure Test.
            b) Main Line Irrigation test and observation.
        3) Record drawings: As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
            a) Detail and dimension changes made during construction.
            b) Significant details and dimensions not shown in original Contract Documents.
            c) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, soil moisture sensors (if soil moisture sensor technology is selected for the site) and both ends of sleeves.
            d) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
            e) Take and record dimensions at time of installation.
            f) Reduced copy of record drawings to 11 by 17 inches (275 by 425 mm), with color key circuits and laminated both sides with 5 mil thick or heavier plastic. Mount on 12 x 18 inch (300 by 450 mm) hard board drilled with (2) two 1/2 inch (13 mm) holes at top of board and hang on hooks in Custodial Room or location designated by Owner’s Representative.
            g) Two (2) additional reduced copies of record drawings to 11 by 17 inches (275 by 425 mm), with color key circuits, unlamented, and unmounted to be given to Owner’s Representative.
2. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Landscape Architect and Owner.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.

2. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.

B. Qualifications:
   1. Installer Qualifications:
      a. General:
         1) Perform installation under direction of foreman or supervisor with five (5) years minimum experience in sprinkling system installations.

C. Mockups:
   1. Provide Mock-Ups of each detail within a valve box at the staging area for review by Landscape Architect prior to installation of the irrigation system.
   2. These mock-ups may be installed without solvent weld cement so that they can later be used in the field.
   3. Mock-ups shall include a complete installation included gravel sump, equipment assembly, valve box placement and branding in conformance with these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Storage and handling during installation, protect materials from damage and prolonged exposure to sunlight.

1.7 WARRANTY

A. Manufacturer Warranty:
   1. Standard one year guarantee shall include:
      a. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
      b. Adjusting system to supply proper coverage of areas to receive water.
      c. Ensuring system can be adequately drained.
   2. Automatic SMART Controller:
      a. Provide Manufacturer's extended warranty for five (5) years to be free of design, materials and workmanship defects.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List (for reference only):
      a. 3M, Austin, TX www.3m.com/elpd.
      b. Action Machining Inc, Bountiful, UT www.actionfilters.com.
      c. Carson Industries LLC, Glendora, CA www.carsonind.com.
      d. King Innovation, St Charles, MO www.kinginovation.com.
      e. Netafim, Inc. www.netafimusa.com.
      f. Nibco Inc., Elkhart, IN www.nibco.com.
      g. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
      h. Weathermatic Irrigation Products, Garland, TX www.weathermatic.com.

B. Distributors:
   1. Category Four Approved Distributors.
   2. Hydro Point Data Systems, Inc. (makers of Weather TRAK) Petaluma, CA www.hydropoint.com.
      a. Preferred Distributor:
         1) Utah:
            a) Sprinkler Supply - West Jordan, UT, Contact: Joe Jackson (801) 404-1371 (801) 566-8172 joe@sprinklersupplyco.com.

C. Materials:
   1. Rock-Free Soil:
      a. Backfill soil around PVC pipe.
      b. Soil having rocks no larger than 1/2 inch (13 mm) in any dimension.
   2. Pea Gravel:
      a. For use around drains, valves, and quick couplers.
      b. 1/2 inch (13 mm) maximum dimension, washed rock.
   3. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.
   4. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over 1-1/2 inches (38 mm).
   5. Topsoil: Remove rocks, roots, sticks, clods, debris, and other foreign matter over 1-1/2 inches (38 mm) longest dimension encountered during trenching.
   6. Pipe, Pipe Fittings, And Connections:
      a. Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
      b. Pipe sizes shown on Drawings are minimum. Larger sizes may be substituted if at no additional cost to Owner.
      c. Northern Climate Zone Pipe:
         1) Pressure Lines: Schedule 40 PVC or SIDR 15 HDPE 3408 100 lb Polyethelene
         2) Lateral Lines: Schedule 40 PVC.
         3) Quick Coupler Piping: Galvanized steel.
      d. Fittings: Insert fittings with clamps (double clamp @ valves).
      e. Sleeves:
         1) Under Parking Area and Driveway Paving: Class 200 PVC Pipe.
         2) All Other: Class 200 PVC Pipe.
         3) Sleeve diameter shall be two times larger than pipe installed in sleeve.
   7. Sprinkler Heads:
      a. Each type of head shall be product of single manufacturer.
      b. Shrub Head Bubblers:
         1) Category Four Approved Products.
            a) Rainbird
      c. Spray Heads in Shrub and Ground Cover Areas:
         1) Category Four Approved Products.
            a) Rainbird 1800 – PRS pop up with match precipitation rate nozzles
            b) Pop-up height shall be 6” or greater in shrub beds
            c) Design for 30 psi at each head
      d. Spray Heads in Lawn Areas:
         1) Category Four Approved Products.
            a) Rainbird 1800 – PRS pop up with match precipitation rate nozzles
            b) Pop-up height shall be 4” or greater in turf areas
            c) Design for 30 psi at each head
   8. Sprinkler Risers:
      a. All stationary spray heads shall have Rain Bird model SA125050; Blu-lock model BLJ-050-SS-12 pre-manufactured swing assemblies or equal as approved by

Landscape Architect before installation. Swing assembly shall be 1/2" x 1/2" x 12" (13 mm x 13 mm x 300 mm) NPT/Bullock.

b. Pop-up rotor sprinkler heads shall have adjustable riser assembly, three ell swing joint assembly, unless detailed otherwise on Drawings. These swing joint fittings shall be of schedule 40 PVC plastic and nipples schedule 80 gray PVC unless otherwise designated on Drawings. Horizontal nipple parallel to side of lateral line shall be 8 inches (200 mm) long minimum. All other nipples on swing joint riser shall be of length required for proper installation of sprinkler heads.

c. Pop-up sprinkler heads, shrub spray heads, bubbler heads, and stationary spray sprinkler heads shall have risers made up one of the following ways:
   1) Three schedule 40 street ells or Marlex street ells connected to lateral tee to form an adjustable riser or pop-up riser as detailed.
   2) Risers for sprinkler heads 14 inches (355 mm) long minimum and 24 inches (610 mm) maximum.

9. Automatic Irrigation Control Wiring And Controller:
   a. Control wire shall be UF-UL listed, color coded PE insulated copper conductor direct burial size 14. Wire runs to turf and shrub areas shall be different colors.
   b. Turf area hot wires shall be red in color with one (1) spare each, hot & ground wire, run to the most distant valve. Use 18 ga. Multi-strand irrigation wire with enough wires for 2 spares to farthest valve.
   c. Shrub area hot wires shall be green in color with one (1) spare each, hot & ground wire, run to the most distant valve. Use 18 ga. Multi-strand irrigation wire with enough wires for 2 spares to farthest valve.
   d. Ground wires shall be white in color with blue spare.
   e. All wire connections shall be soldered and be sealed water tight.
   f. All connection shall be located in valve boxes with 18” coil for each wire.
10. Valves:
   a. Manual Drain Valves:
      1) Approved Products.
         a) Mueller Orseal – ¾” Standard
         b) Provide 2” class 200 PVC sleeve to valve and cap with 6” round valve box.
   b. Automatic Valves:
      1) Approved Products.
         a) Rainbird: PESB-(PRS-D if required)
         b) Size range from 1” to 2” as required
         c) Install two valves per jumbo box if 1” in size
         d) Install one valve per jumbo box if 1.5” or greater in size
   c. Isolation Valves:
      1) Nibco T-113 non-rising stem gate valve, size to match pipe size
      2) Class Two Quality Standards.
         a) Rainbird: BV Series.
         b) Salco
   d. Backflow Preventer: (NOT APPLICABLE)
   e. Secondary Water Filter: VAF (V-200PA-3N-300E) w/ locking enclosure as referenced in drawings
   f. Valve Boxes And Extensions:
         a) Lid Colors:
            (1) Green: Lawn areas (potable and secondary water).
            (2) Brown: Bare soil and rock areas (potable and secondary water).
            (3) Purple: Reclaimed water.
         b) Valve Box:
            (1) Model 1730 Valve Box by Carson Industries.
   g. Hydrometer:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Netafim:
(1) Acclima: LHM15TG1-MEL, LHM2TG1-MEL.

h. Pressure Reducing Valve: Make and model shown on Drawings or as required by local code and approved by Owner.
i. Quick Coupling Valves and Keys:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Rainbird: 5-NP

11. Valve Accessories:
a. Valve manifolds:
1) Type Two Acceptable Products.
a) Action: 1800 Series, Models 18001, and 18002, 1, 1-1/2, and 2 inch (25, 38, and 50 mm) sizes.
b) Hydro-Rain: HRM Series.
c) Rainbird: MS Series.
d) Equals as approved by Landscape Architect before use.
b. Valve Boxes And Extensions:
1) Lid Colors:
a) Green: Lawn areas (potable and secondary water).
b) Brown: Bare soil and rock areas (potable and secondary water).
c) Purple: Reclaimed water.
2) Type Two Acceptable Products:
a) Rainbird: VB-STD, VB-JMB, VB-STDT or VB-JMT Series, VB-STDP or VB-JMBP Series, VB-MAX series.
b) Orbit: 53983, 53993, 53753, 53985, 53755, 53995 (with extension boxes).
c) Carson Industries: Model 1419-12, Model 1419-18, Model 1730-18 Jumbo.
d) Equal as approved by Landscape Architect before use.
c. Valve ID tags:
1) Type Two Acceptable Products:
a) Rainbird: VID1Y24, VID24Y48, VID1P24, VID24P48.
b) Equal as approved by Landscape Architect before use.
c) Valve Box Supports: Standard size fired clay paving bricks without holes or compacted gravel base.

12. Drip System: Rainbird XCZ-150-PRB-COM drip valves
Rainbird XFCV-09-18 drip line w/components for installation

13. Irrigation Controller
a. Accetable Products:
1) 24 Station Weather TRAK PRO-3 (WT-WTPRO3-C-24-CWM)
a) Weather TRAK 10 YR additional Central Service (WT-C1M010YA)
b) 5yr Additional Hardware Warranty (WT-WAR-10Y)
c) Onsite Consultation (WT-SITECONSULT)

14. Other Components:
a. Recommended by Manufacturer and subject to Landscape Architect's review and acceptance before installation.
b. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved irrigation system installers shall be pre-approved by Owner.

3.2 EXAMINATION

A. Verification Of Conditions:
   1. Identify main line tie in locations.
   2. Locate and route existing zones as necessary for continued operation during and post construction.
   3. Coordinate with USU LOAM for final zone configuration – controller location, etc.

3.3 PREPARATION

A. Protection:
   1. Protection Of In-Place Conditions:
      a. Repair or replace work damaged during course of the Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
      b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.

B. Surface Preparation:
   1. Layout of Irrigation Heads:
      a. Location of heads and piping shown on Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.
      b. During layout, consult with Landscape Architect to verify proper placement and make recommendations, where revisions are advisable.
      c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
      d. Make certain changes from Contract Documents are shown on record drawings.

3.4 INSTALLATION

A. Trenching And Backfilling:
   1. Pulling of pipe is not permitted.
   2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch (38 mm) in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch (38 mm) in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
   3. Cover pipe both top and sides with 2 inches (50 mm) of rock-free soil as specified under PART 2 PRODUCTS. Remainder of backfill to within 5 inches (125 mm) of finish grade shall be as specified in Section 31 2323. Top 5 inches (125 mm) of backfill shall be topsoil as specified in Section 32 9113.
   4. Do not cover pressure main, irrigation pipe, or fittings until Landscape Architect has inspected and approved system.

B. Sleeving:
   1. Sleeve water lines and control wires under walks and paving. Extend sleeves 6 inches (150 mm) minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
   2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.

C. Grades And Draining:

1. In localities where winterization is required, grade piping so system can be completely drained or blown out with compressed air. If system is not designed to be blown out with compressed air:
   a. Slope pipe to drain to control valve box where possible.
   b. Where this is not possible, slope pipe to a minimum number of low points. At these low points, install:
      1) 3/4 inch (19 mm) brass ball valve for manual drain. Do not use automatic drain valves.
      2) Install 2 inch (50 mm) Class 200 PVC pipe over top of drain and cut at finish grade.
      3) Provide rubber valve cap marker.
      4) Provide one cu ft (0.03 cu m) pea gravel sump at outlet of each drain.
   c. Slope pipes under parking areas or driveways to drain outside these areas.
   d. Provide and install quick-coupling valve or valves in location for easy blowout of entire system. Install quick coupler valves with 4 lineal feet (1.20 m) minimum of Schedule 80 PVC pipe between valve and main line.

D. Installation of Pipe:
   1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
   2. Unless otherwise indicated on Drawings, install main lines and lateral lines connecting pop-up rotor and impact sprinklers with minimum cover of 18 inches (450 mm) based on finished grade. Install remaining lateral lines, including those connecting drip tubing, with minimum of 12 inches (300 mm) of cover based on finish grade.
   3. Main line and lateral line piping may not be placed in the same trench. See Drawings.
   4. Install pipe and wires under driveways or parking areas in specified sleeves 18 inches (450 mm) below finish grade or as shown on Drawings.
   5. Locate no sprinkler head closer than 12 inches (300 mm) from building foundation. Heads immediately adjacent to mow strips, walks, or curbs shall be one inch (25 mm) below top of mow strip, walk, or curb and have 3 inches 75 mm clearance between head and mow strip, walk, or curb.
   6. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
   7. Make solvent weld joints as follows:
      a. Do not make solvent weld joints if ambient temperature is below 35 deg F (2 deg C).
      b. Clean mating pipe and fitting with clean, dry cloth and apply one coat of P-70 primer to each.
      c. Apply uniform coat of 711 solvent to outside of pipe.
      d. Apply solvent to fitting in similar manner.
      e. Give pipe or fitting a quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
      f. Allow joints to set at least 24 hours before applying pressure to PVC pipe.
   8. Tape threaded connections with Teflon tape.
   9. If pipe is larger than 3 inches (75 mm), install concrete thrust blocks wherever change of direction occurs on PVC main pressure lines.

E. Control Valves And Controller:
   1. Install valves in plastic boxes with reinforced heavy duty plastic covers. Locate valve boxes within 12 inches (300 mm) of sidewalks and shrub bed edges with tops at finish grade. Do not install more than two valves in single box.
   2. Place 3 inches (75 mm) minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.

3. Wiring:
   a. Tape control wire to side of main line every 10 feet (3.050 m). Where control wire leaves main or lateral line, enclose it in gray conduit.
   b. Use waterproof wire connectors consisting of properly-sized wire nut and grease cap at splices and locate all splices within valve boxes.
   c. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one controller.
   d. Run two spare control wires from panel continuously from valve to valve throughout system similar to common wire for use as a replacement if a wire fails. Spare wires shall be different colors than other wires, and included in multi-strand cable. Mark spare control wire in control box as an unconnected wire. Extend spare control wires 24 inches (600 mm) and leave coiled in each valve box.

F. Backflow Preventer: (NOT APPLICABLE)

G. Sprinkler Heads:
   1. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.
   2. Do not install sprinklers using side inlets. Install using base inlets only.
   3. Set sprinkler heads at a consistent distance from existing walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.

H. Drip Assembly: (NOT APPLICABLE)

I. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.

3.5 FIELD QUALITY CONTROL

A. Field Tests:
   1. Main Line:
      a. Before backfilling main line, test pressure at 120 psi (~~690 kPA~~) minimum for two (2) hours minimum and make certain there are no leaks.
         1) A report of the test results along with photographs of the testing process are to be provided by the landscape Architect or his authorized representative at completion of testing.
         2) This report shall be included along with the acceptance certificate at the end of the project to the Owner.
         3) Notify Landscape Architect two (2) working days minimum before conducting test.
      b. Test report:
         1) Report of test results along with photographs of testing process are to be provided by Landscape Architect or his authorized representative at completion of testing.
         2) This report shall be included in Operations and Maintenance Manual along with acceptance certificate at end of Project.
      c. Notify Landscape Architect two (2) working days minimum before conducting test.

B. Field Inspections:
   1. Landscape Architect's irrigation design consultant, or certified water auditor recommended by consultant and approved in writing by Landscape Architect, will review irrigation system before substantial completion.

2. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be accepted following spring, after system can be checked for proper operation.
3. Upon acceptance of irrigation system, reviewer will provide signed acceptance certificate.

C. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
1. Automatic SMART Controller:
a. Correct or replace any work found defective or not complying with contract document requirements at no additional cost to the Owner.

3.6 ADJUSTING

A. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.

B. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.

C. Adjust watering time of valves to provide proper amounts of water to plants.

3.7 MAINTENANCE

A. Contractor shall assist USU personnel with first year winterization of system and with second year start up of the system.

END OF SECTION 32 8423

SECTION 32 9001

COMMON PLANTING REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Includes but not limited to:
1. Common procedures and requirements for site landscaping work.
2. Procedures, requirements, products and materials for roof plantings and installation.
3. Provide maintenance for all new landscaping as described in Contract Documents.

B. Related Requirements: Related Sections include the following:
1. 31 2216 Fine Grading
2. 32 8423 Underground Sprinklers
3. 32 9001 Common Planting
4. 32 9113 Soil Preparation
5. 32 9120 Topsoil Placement & Grading
6. 32 9223 Sodding
7. 32 9300 Plants
8. 07 5563 Vegetated Roof Assembly

C. Definitions
1. Green Roof – an area of planting/landscaping, built up on a waterproofed substrate at any level that is separated from the natural ground by a man-made structure.
2. Intensive Green Roof – Landscaping requiring regular maintenance, consisting of deeper media depths (>6 inches) with a wider variety of plant species possible including shrubs and small trees.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
1. Schedule pre-installation conference is required prior to starting planting.
2. Schedule planting pre-installation conference after completion of Fine Grading specified in Section 31 2216, but before beginning landscape work.
3. During the meeting specific agenda items shall be established to review the following:
   a. Establish responsibility for maintenance of new landscaping during all phases of construction period.
   b. Prepare two typical landscape-planting excavations and conduct percolation test to verify that water drains away within two hours. Discuss results of percolation tests with Landscape Architect and Owner's representative.
   c. Roof planting design:
      1) Review green roof standardized installation procedures.
      2) Verify that certified installation personnel are scheduled to supervise entire green roof installation.
      3) Ensure edging is appropriately perforated to allow water to freely drain and is sufficient to contain the soil
      4) Discuss proposed installation procedure to minimize or eliminate walking on plants during installation.

1.03 SUBMITTALS

A. Action Submittals:

1. Roof Planting:
   a. Provide growing media mix design & lab results of organic matter to meet the Hydrotech LiteTop® specifications.
   b. Provide product/system maintenance and warranty information.
   c. Provide two sample vegetated areas roughly 2'x2' each showing the same or similar product grown to maturity. Samples to be reviewed and accepted by Landscape Architect and Owner.
   d. Provide green roof system wind uplift rating according to "Standard test method for wind resistance of modular vegetated roof assembly (CAN/CSA-A 123.24-15)."
   e. Provide written documentation of green roof system installation procedures.
   f. Submit plant substitutions from manufacturer to be reviewed and accepted by Landscape Architect prior to delivery to site.

B. Closeout & Acceptance Submittals:
1. Include following:
   a. Conduct Substantial Completion walkthrough with Landscape Architect & Owner:
      1) Landscape Architect to generate punch list of items to complete during substantial completion walkthrough.
      2) At completion of all punch list items, Contractor shall submit two copies of typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work and plantings.
      3) Roof planting area:
         a) Owner and maintenance staff to attend on-site maintenance training with manufacturer representative
         b) Submit green roof system manufacturer warranty issued in Owner's name.

1.04 QUALITY ASSURANCE

A. Qualifications:
1. Site Planting Installer:
   a. Use trained personnel familiar with required planting procedures and with Contract Documents.
   b. Planting shall be performed under direction of foreman or supervisor with minimum five years' experience in landscape installations.
1. Roof Planting Installer:
   a. American Hydrotech "Intensive Garden Roof Assembly" is the specified basis of design system for planting design – equals approved by Landscape Architect.
   b. Selected installer is responsible for ensuring adequate installation of all system component parts and coordinating work with other disciplines.
   c. Manufacturer approved installers recommended.
   d. Prior to installation installer to verify the following:
      1) The building Owner or Architect shall verify that the roof is properly designed and constructed to adequately support the load of the vegetated roof assembly.
      2) The roof is to be flood tested for water tightness for 24 hours. Water testing shall be witnessed and confirmed in writing by Owner's Representative and/or Design Professional, Waterproofing Contractor, Membrane Manufacturer and Installation Contractor.
      3) Contractor to ensure proper installation of all system substrate materials prior to installation of growing medium in accord with architect's and manufacturer's specifications.

4) The roof is to be inspected and determined ready to accept the vegetated roof assembly growing media by a Technical Representative of the Installer.

e. Upon completion of installation and inspection is to be conducted by the system manufacturer's technical representative to verify that the vegetated assemblies have been installed properly in conjunction with adjacent materials, irrigation system & components and against exterior walls.

1.05 DELIVERY, STORAGE, HANDLING & PROTECTION

A. Site Plant Material Storage and Handling Requirements:
   1. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
   2. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition.
   3. Protect materials from deterioration during delivery.
   4. Store in location on-site where plants will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
   5. Protect materials for deterioration while stored at site.

B. Roof Plant Material Storage and Handling Requirements:
   1. Hydrotech InstaGreen Sedum Carpet to be installed per manufacturers guidelines.

PART 2 - PRODUCTS

2.01 VEGETATED GREEN ROOF GROWING MEDIUM

A. Contractor to provide Hydrotech LiteTop® Growing medium. Submittal required.

2.02 VEGETATED GREEN ROOF PLANTS

A. Hydrotech InstaGreen® Sedum Carpet. Submittal required.
B. Other plants as shown on roof planting plan schedule.

2.03 VEGETATED GREEN ROOF ACCESSORIES

A. Irrigation System:

   1. See roof irrigation plan for supply line locations and basis of design
   2. System to be field constructed to meet Hydrotech Intensive Garden Roof System standards and recommendations. Contractor to work with Hydrotech to provide optimal water application to vegetated areas. Shop drawings of proposed irrigation system required.
   3. System to be used only to keep green roof in optimal condition during prolonged periods of heat and drought and to optimize the evaporative cooling effect of the green roof during such weather events.
      a. Sloped green roof applications will drain more quickly, thus potentially thinning plants and exposing soil to erosion, and therefore will have an increased need for irrigation.
      b. Reflective walls or windows will increase effects of sun exposure on plants and may require special plant selections and/or more frequent irrigation.

c. Use a standard SCH 40 PVC subterranean, or surface applied UV-resistant, preferably green painted SCH 40 PVC (Polyvinyl Chloride Plastic) pipe for irrigation lines, with SCH 80 solvent weld PVC fittings. Matched precipitation irrigation head recommended.
d. Consult a qualified irrigation specialist to determine appropriate design configuration of irrigation, including pipe diameter, layout, head style and spacing – See drawings.

PART 3 - EXECUTION

3.01 INSTALLERS

A. Site Planting:

1. General Contractor to determine qualifications of landscape installer. It is recommended that any installer have a minimum of five (5) years experience in landscape installation.

B. Roof Planting:

1. Hydrotech Intensive Roof Garden System installer or other approved system manufacturer – certified installer required. It is recommended that any installer have a minimum of five (5) years experience in roof garden installation.

3.02 EXAMINATION

A. Site Planting:

1. Verification of conditions:
   a. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities.
   b. Repair damage to irrigation, ground lighting, and utilities and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.03 PREPARATION

A. Site Planting:

1. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with landscape work.
   a. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
   b. All planting indicated by symbols on Drawings is required unless indicated otherwise.

B. Roof Planting:

3. All surfaces to be smooth, free of debris, soil, and grit prior to placing growing medium. All materials to be tested watertight and free draining prior to growing media placement.

4. All surfaces to be maintained clean and free of debris, soil, and grit during installation process via use of broom. Never walk upon such materials as they may damage membranes.

3.04 INSTALLATION OF SITE PLANTING AREAS

A. Interface with other work:
   1. Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Section 31 2216 and Section 32 8423 has been completed and approved.

B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

C. Hand excavate as required to avoid damage to existing utilities, tree roots, building foundations and completed new construction.

D. Maintain grade stakes until parties concerned mutually agree upon removal.

E. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Landscape Architect before planting.

F. Roof Planting:
   1. When plants are properly adapted and acclimatized to local weather conditions.
   2. When weather is above 35° F and there is no ice on the roof and engineered soil is unfrozen.
   3. No later than the cutoff date required by the green roof system provider's warranty terms, if applicable.

3.06 FIELD QUALITY CONTROL

A. Site Planting Field Inspection:
   1. Landscape Architect will inspect landscaping installation approximately two weeks before Substantial Completion.
   2. Replace landscaping that is dead or appears dead as directed by Landscape Architect within 10 days of notification and before Substantial Completion.

3.07 CLEANING

A. General Waste Management for Site and Roof Planting Areas:
   1. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.
   2. Throughout installation, keep all work surfaces clean and free of grit, dirt, or debris. Use broom not blower on roof areas, do not sweep soil under modules or filter fabric. Following installation, remove all excess materials and tools from job site. Ensure that any damage that occurs as result of installation is appropriately and immediately repaired.

3.08 PROTECTION

A. Take care in performing landscaping work to avoid conditions that will create hazards.

B. Post signs or barriers as required.

C. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc.

D. Repair or replace damaged areas. Keep site well drained and landscape excavations dry.
E. Verify with Landscape Architect that the irrigation system is fully functional before beginning planting.

3.09 CLOSEOUT ACTIVITIES & ACCEPTANCE

A. Site Planting Areas:

1. Conduct walkthrough with Owner and Landscape Architect.

2. Landscape Architect to prepare punch list of items to be complete

3. Complete Punch list items & follow instruction of Owner to complete closeout.

B. Roof Planting Areas:

1. Conduct post installation inspection to determine acceptance of modules. Inspection to be made by General Contractor's Representative or by Owner's Representative upon General Contractor's request; five working days notice required.
2. Installer is responsible to complete requirements to obtain confirmation of warranty from the green roof systems manufacturer.
3. Installer is responsible to ensure proper module/plant maintenance until work has been accepted by representative of Owner or General Contractor.
4. Upon acceptance, Owner assumes responsibility for module/plant maintenance unless otherwise specified.

3.10 MAINTENANCE OF SITE PLANTING AREAS

A. General:
1. Plants shall be in maintained as sound, healthy, vigorous, and in approved condition as when delivered to site, until accepted by Landscape Architect in writing at final landscape inspection.
2. Replace damaged or dead plantings as necessary until final acceptance at no additional cost to Owner.
3. Maintain existing and newly installed landscaping from beginning to completion of landscape installation until 7 days after Substantial Completion Meeting or until all punch list items are complete, whichever is longer.
4. Areas sodded or seeded after November 1st will be accepted the following spring, approximately one month after start of growing season, May 1st or as determined by Landscape Architect, if specified conditions have been met.
5. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Landscape Architect at the Substantial Completion Meeting. Make replacements within 10 days of notification.
6. Lawn that does not live and has to be replaced shall be guaranteed 30 days from date of installation or replacement.

B. Seeded Lawn Areas:
1. N/A

C. Sodded Lawn:
   1. Maintain sodded lawn areas until lawn complies with specified requirements and throughout landscape installation period.
   2. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches (75 to 100 mm) deep.
   3. Cut grass first time when it reaches 3 inches (75 mm) high.
   4. Grass shall be cut a minimum of twice by Contractor prior to final acceptance.

D. Trees, Shrubs, and Plants:
   1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
   2. Restore planting basins.
   3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
   4. Spray as required to keep trees and shrubs free of insects and disease.
   5. Provide supplemental water by hand as needed for establishment in addition to water from sprinkling system.

3.11 MAINTENANCE OF ROOF PLANTING AREAS

A. Documentation

   1. Record all green roof maintenance events. Include name of person, date and activity.
      a. If soil test, record lab, test, and results
      b. If fertilizer, record type and amount applied per 1000 SF
      c. Record time needed for bi-weekly weed walk and drain inspection
      d. If irrigation, record duration and quantity

B. Foot Traffic: Limit foot traffic to a random path a couple times per week by one person. Avoid walking in a single path, standing in one place, or trampling plants. If parapet or adjoining wall must be serviced, plants may be covered with plywood or foam sheeting for up to 4 hours intermittently, provided foliage is not wet or frozen and conditions are not too hot or sunny.

C. Spring Maintenance (March to June)

   1. Soil Testing and Fertilization. Approximately 2-3 weeks before spring "growth flush," administer an annual soil test for PH and fertility levels. Growth flush varies by region, consult biweekly maintenance protocol email for specific recommended testing date in project's region.
   2. Maintain pH in the range of 6.5 to 8.0. In the event that pH falls below 6.0, consult the testing lab for appropriate recommendations to increase alkalinity. If the soil is above 8.0, it can be made more acidic with elemental sulphur or an application of acidifying fertilizer.
   3. Maintain fertility in the normal range using a typical field soil fertility test as provided by USU analytical labs or equivalent testing lab. Evaluate the various nutrient levels such as Nitrogen (N or NO3N), Potassium (K), Phosphorus (P). If the soil contains a low (L) amount of these nutrients, conduct a single application of a high-quality controlled release fertilizer at the lab recommended rate. Ensure that the chosen fertilizer contains NO Herbicides or Pesticides. Follow the fertilizer labeled directions for application rate and use a rotary spreader to ensure even fertilizer application. Runoff potential does exist and should be evaluated by the applicator in accord with the site specifics; the greater the runoff sensitivity, the lower the application rate. All applications of fertilizer are the sole responsibility of the applicator.
   4. Mowing (optional)
      a. If desired, conduct a single annual mowing in early April. Set the mower blade just above the foliage in order to remove dried seed heads. Do not bag the clippings;

instead, blow them into the green roof so that they can decompose and nourish the soil.
   b. Be safe, use protective equipment, including harnesses if required. Make sure the roof is free of frost or other slipping hazards.
5. Conduct Biweekly Inspections
   a. Weed Walk: Pull and dispose of all weeds before they flower and set seed. NEVER allow any woody plant to establish in a green roof system, as they have deep root systems which can damage roofing membranes.
   b. Displaced Soil: Nesting birds may displace soil. Replace lost soil using only green roof manufacturer approved engineered green roof soil.
   c. Drainage Inspection: Inspect roof drains for any debris, pebbles or leaves and remove to ensure proper drainage.
   d. Debris Removal: Remove any debris blown onto the roof immediately to ensure no damage to plants.
   e. Pest Control: Monitor pest presence, as most pest problems are the result of an imbalance in the relationship of pest organism and its natural biological controls and these problems may self-correct. If pest problems are persistent, use organic and natural biological control agents to restore balance. Pesticide use is discouraged and should always be considered secondary to cultural and biological control measures, as pesticides can contaminate runoff water and cause environmental damage. Pesticides shall only be applied by qualified and licensed applicators, and only as required. All applications of pesticides are the sole responsibility of the applicator.

D. Summer Maintenance (June to September)

1. Conduct Biweekly Inspections
2. Irrigation
   a. When planted with drought tolerant succulents, irrigation recommended as a temporary management tool during prolonged hot dry weather to prevent plant thinning or death. Prolonged hot dry weather is generally defined as periods of 75° F weather with less than 1" of rainfall persisting for 2 weeks for the Lite system and 4 weeks for all other systems. This time period will be less if the temperatures are hotter, the climate warmer, on sloping roofs, and roofs exposed to persistent winds or reflected sunlight. Such conditions can dry out the soil and can cause plant dormancy or, in extreme cases, death.
   b. Except when populated solely with drought tolerant succulents such as Sedums, Sempervivums, and Alliums, the green roof modules may require frequent irrigation if populated with native or conventional (non-succulent) perennials or grasses.
   c. There are no absolutes when it comes to irrigation. Check the plants for wilting in the afternoon. Water thoroughly to runoff to remoisten entire soil profile if the plants show signs of wilting.
   d. Shaded areas require less irrigation.

E. Fall Maintenance (October to November)

1. Conduct Biweekly Inspections, unless ice or frost is present.
2. Do Not Fertilize during the fall. It may stimulate tender growth and compromise the cold hardiness of the plant material.
3. Do Not Water Period: For the northern temperate zone, it is recommended that maintenance contractors do not water within 4 weeks of the expected average frost date. Normally, there is plenty of moisture this time of year, and adding additional water may compromise the durability of the plants to endure winter's cold. For this reason, watering during the winter is also not recommended.
4. Blow out irrigation system with compressed air no greater than 60 psi prior to reaching freezing temperatures.

5. Rake, bag and remove fallen and matted leaves. These can smother the green roof plants.

F. Winter Maintenance

1. Northern Temperate Climates
   a. Watering is not recommended.
   b. Avoid walking on frozen plants and roof surfaces as they are slippery and dangerous.
   c. If clear pathways are needed, avoid using salt and other deicing chemicals, which may kill plants and damage pavers. Instead, use sand or cat litter as an anti-slip agents. Consider use of heat strips with pavers, provided they can be applied without damage to the roofing membrane.
   d. Avoid piling the snow in a single place. Disperse snow evenly over the green roof plantings as excess snow piling can potentially damage plants by insulating the plants and keeping them warm and wet, thereby triggering fungal diseases.

2. Warm Climates – N/A

END OF SECTION 32 9001

SECTION 32 9113

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform soil preparation work as described in Contract Documents.
   2. Furnish and apply soil additives as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM 1557-02, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

Related Sections include the following:
   1. 32 8423 Underground Sprinklers
   2. 32 9001 Common Planting
   3. 32 9113 Soil Preparation
   4. 32 9120 Topsoil Placement & Grading
   5. 32 9223 Sodding
   6. 32 9300 Plants

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Schedule pre-installation conference.
   2. Specific agenda items for pre-installation conference:
      a. Review on-site and import topsoil test results & recommendations
      b. Review soil amendments and fertilizer requirements.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
   2. Samples:
      a. Sample of soil conditioner for approval before delivery to site. Include product analysis list.

B. Informational Submittals:
   1. Installer Reports:
      a. Delivery slips indicating amount of soil conditioner delivered to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Incorporate following soil amendments into topsoil used for Project. Do not apply additional fertilizer if GroPower Plus soil conditioner is used.
   1. Acceptable Soil Amendments, Soil Conditioners, and Application Rates. (Choose one):
      a. Soil Pep and Utelite Soil Conditioner:
         1) Lawn Areas
            a) Contractor to provide minimum depth of 12” amended soil consisting of 10% “Soil Pep”, 10% Utelite Soil Conditioner and 80% excavated topsoil from site. 12” depth of soil shall take into account a compaction/soil settling factor of 15%.
         2) Planter Areas
            a) Contractor to provide minimum depth of 18” amended soil consisting of 20% “Soil Pep”, 20% Utelite Soil Conditioner and 60% excavated topsoil from site. 18” depth of soil shall take into account a compaction/soil settling factor of 15%.
      b. Equals as approved by Landscape Architect before use.

   2. Acceptable Fertilizers And Application Rates:
      a. GroPower Plus soil conditioner by GroPower Inc., Chino, CA www.gropower.com. Apply as directed on package.
      b. Equal as approved by Landscape Architect before installation.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Add soil amendments recommended in topsoil test report at specified rates to lawn areas. Roto-till or otherwise mix amendments evenly into top 4 inches (100 mm) of topsoil. Incorporate and leach soil amendments which require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer and soil conditioners.

END OF SECTION 32 9113

SECTION 32 9120

TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform topsoil placement and grading work required to prepare site for installation of landscaping as described in Contract Documents.
   2. Furnish and apply soil additives as described in Section 32 9113 Soil Preparation.

B. Related Sections include the following:
   1. 32 8423 Underground Sprinklers
   2. 32 9001 Common Planting
   3. 32 9113 Soil Preparation
   4. 32 9120 Topsoil Placement & Grading
   5 32 9223 Sodding
   6. 32 9300 Plants

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D1557-07, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in landscape pre-installation conference.

1.4 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
   2. Samples:
      a. Sample of soil conditioner for approval before delivery to site. Include product analysis list.

B. Informational Submittals:
   1. Field Quality Control Submittals:
      a. Topsoil to meet characteristics described in Part 2 of this specification.
      b. Topsoil shall in no way impede, cause detriment to or adversely affect growth of proposed plant materials, by over compaction and/or poor chemical or physical characteristics.

c. If deemed necessary and required for verification the Contractor shall provide and submit tests on imported and site topsoil by licensed laboratory to Landscape Architect.
   1) Topsoil shall meet minimum specified requirements and be approved by Landscape Architect.
   2) If necessary, submit proposed amendments and application rates necessary to bring topsoil up to minimum specified requirements.

d. Submit report stating location of source of imported topsoil and account of recent use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. Topsoil used in landscaped areas (lawn and planter areas), whether imported or from site, shall be fertile, loose, friable soil meeting following criteria:
      a. Chemical Characteristics:
         1) Acidity / alkalinity range: pH 5.5 to 8.0.
         2) Soluble Salts: less than 3.0 mmhos/cm.
         3) Sodium Absorption Ratio (SAR): less than 6.0.
         4) Organic Matter: greater than one percent.
      b. Physical Characteristics:
         1) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
            a) Sand: 15 to 60 percent.
            b) Silt: 10 to 60 percent.
            c) Clay: 5 to 30 percent.
         2) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
         3) Soil shall not contain more than 2 percent by volume of rocks measuring over 3/32 inch (2 mm) in largest size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of existing site conditions:
   1. Contractor to ensure viability of any on-site topsoil to be used and that topsoil meets chemical and physical characteristics defined in Section 2.1 of this specification. If necessary, the Contractor shall conduct topsoil test of existing site topsoil by licensed laboratory. Contractor to provide testing results to Landscape Architect.
   2. If topsoil is inadequate or if more topsoil is required for project to meet standards, imported topsoil may be used. Contractor to ensure viability of any imported topsoil to be used and that topsoil meets chemical and physical characteristics defined in Section 2.1 of this specification. If necessary, the Contractor shall conduct topsoil test of imported topsoil by licensed laboratory. Contractor to provide testing results to Landscape Architect.

3.2 PREPARATION

A. Protection of in place site conditions:
   1. Protect utilities and site elements from damage during topsoil placement and fined grading

B. Surface Preparation:
   1. Disk, till, or aerate with approved agricultural aerator to depth of 6 inches in lawn areas and 10 inches in planter areas.
   2. Seven days maximum before beginning seeding and planting:
      a. Loosen area 6 inches deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
      b. Rake area to remove clods, rocks, weeds, roots, and debris.
      c. Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
   3. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet.

3.3 PERFORMANCE

A. Tolerances:
   1. Total topsoil depth of 12 inches minimum in lawn and groundcover planting areas.
   2. Total topsoil depth of 18 inches minimum in shrub and tree planting areas.
   3. Finish grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
      a. Sodded Areas: 2 inches below.
      b. Ground Cover, Tree and Shrub Planter Areas: 2 inches below.
         1) These areas to receive minimum 1” of soil pep top dressing after installation of plant materials to bring finish grade to 1” below.
         2) See drawings for reference depth of top dressing material, it varies from bed to bed – final finish grade of all planter areas after application of top dressing or mulch shall be 1” below

B. Do not expose or damage existing shrub or tree roots for all trees that are to remain.

C. Redistribute approved existing topsoil stored on site as a result of work of Section 31 1000 Site Clearing.
   1. Remove organic material, rocks and clods greater than 1-1/2 inch in any dimension, and other objectionable materials.
   2. Provide additional approved imported topsoil required to bring surface to specified elevation relative to concrete site elements.
   3. Do not place topsoil whose moisture content makes it prone to compaction during placement process.

D. Slope grade away from building for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted.
   1. High point of finish grade at building foundations shall be 6 inches (150 mm) minimum below finish floor level.
   2. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water.
   3. Fill low spots and pockets with topsoil and grade to drain properly.

E. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

F. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs, depending on soil type.
   1. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.
   2. If necessary roll lawn areas again after installation of sod.

END OF SECTION 32 9120

SECTION 32 9223

SODDING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install sodded lawn as described in Contract Documents.

B. Related Requirements:

   Related Sections include the following:
   1. 32 8423 Underground Sprinklers
   2. 32 9001 Common Planting
   3. 32 9113 Soil Preparation
   4. 32 9120 Topsoil Placement & Grading
   5. 32 9223 Sodding
   6. 32 9300 Plants

C. Definitions:
   1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETO to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETO value to arrive at a plant ET (Etc.) estimate. Plants grouped by water needs, organized into one irrigation zone.
   2. Reference Evapotranspiration (ETO): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

1.2 SUBMITTALS

A. Informational Submittals:
   1. Source Quality Control Submittals:
      a. Written certification confirming lawn seed quality and mix.

B. Closeout Submittals:
   1. Participate in Substantial Completion Walkthrough
   2. Complete Punch List items

1.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
   1. Harvest, deliver, store, and handle sod in accordance with requirements of Turf grass Producers International (TPI) (formally American Sod Producers Association) Specifications for Turf grass Sod Materials and Transplanting / Installing.
   2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.
      a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
      b. Do not deliver small, irregular, or broken pieces of sod.

B. Storage And Handling Requirements:

1. Cut sod in pieces approximately 3/4 to one inch (19 to 25 mm) thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.
2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
3. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Description:
   1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolon's:
      a. Assure satisfactory genetic identity and purity.
      b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.
   2. Sod shall be composed of five (5) or more varieties minimum of bluegrass. Mix varieties shall consist of those with proven success in full sun, partial shade or full shade.
      a. Seed mix from sod farm shall be submitted for approval prior to purchase and delivery of sod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
   1. Do not commence work of this Section until work of Sections 32 9113 and 32 9300 has been completed and approved.

B. Tolerances:
   1. Final grade of soil after sodding of lawn areas is complete shall be one inch below top of adjacent pavement of any kind.

C. Laying of Sod:
   1. Lay sod during growing season and within 48 hours of being lifted.
   2. Lay sod while top 6 inches (150 mm) of soil is damp, but not muddy. Sodding during freezing temperatures or over frozen soil is not acceptable.
   3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
   4. Lay sod flush with adjoining existing sodded surfaces.
   5. Do not sod slopes steeper than 3:1. Consult with Landscape Architect for alternate treatment.

D. After Laying of Sod Is Complete:
   1. Roll horizontal surface areas in two directions perpendicular to each other.
   2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
   3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches (150 mm) of topsoil.

3.2 FIELD QUALITY CONTROL

A. Field Inspection:
   1. Sodded areas will be accepted at Project closeout if:
      a. Sodded areas are properly established.
      b. Sod is free of bare and dead spots and is without weeds.
      c. No surface soil is visible when grass has been cut to height of 2 inches (50 mm).
   2. Sodded areas have been mowed a minimum of twice.

END OF SECTION 32 9223

SECTION 32 9300

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install landscaping plants as described in Contract Documents.

B. Related Requirements:

   Related Sections include the following:
   1. 32 8423 Underground Sprinklers
   2. 32 9001 Common Planting
   3. 32 9113 Soil Preparation
   4. 32 9120 Topsoil Placement & Grading
   5. 32 9223 Sodding
   6. 32 9300 Plants

C. Definitions:
   1. Reference Evapotranspiration (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

D. Reference Standards:
   1. American Nursery & Landscape Association / American National Standards Institute:
      a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

1.2 SUBMITTALS

A. Action Submittals:
   1. Samples:
      a. Organic Top Dressing Mulch – Only fine ground bark mulch with no material size exceeding 3/8” and free of foreign matter.
      b. Top dressing mulch must be submitted to USU Facilities LOAM for approval before delivery to site.

B. Closeout Submittals:
   1. Include following:
      a. Operations And Maintenance Data:
         1) Installer Instructions:
            a) Provide written instructions covering maintenance requirements by Owner.
      b. Warranty Documentation:
         1) Include final, executed copy of warranty.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately.
2. Do not prune before delivery, except as approved by Landscape Architect.
3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
4. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.
5. Provide protective covering during delivery.

B. Storage And Handling Requirements;
1. Handle balled stock by root ball or container. Do not drop trees and shrubs during delivery.
2. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Landscape Architect. Do not place on pavement.
4. Do not remove container-grown stock from containers before time of planting.
5. Water root systems of trees and shrubs stored on site with fine spray. Water as often as necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

1.4 WARRANTY

A. Special Warranty:
1. Provide written warranties as follows:
   a. Guarantee shrubs, ground covers, and vines to live and remain in strong, vigorous, and healthy condition for one (1) year or one complete growing season, whichever is longer, after date landscape installation is accepted as complete.
   b. Guarantee trees to live and remain in strong, vigorous, and healthy condition for one (1) year or one complete growing season, whichever is longer, from date landscape installation is accepted as complete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plants:
1. Conform to requirements of Plant List and Key on Drawings and to ANLA / ANSI Z60.1.
2. Nomenclature:
   a. Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear a tag showing the genus, species, and variety of at least 10 percent of each species delivered to site.
3. Quality:
   a. Plants shall be sound, healthy, and vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
   b. Do not prune plants or top trees prior to delivery.
   c. Plant materials shall be subject to approval by Landscape Architect as to size, health, quality, and character.
   d. Bare root trees are not acceptable.
   e. Provide plant materials from licensed nursery or grower.
4. Measurements:

a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Drawings or Plant List.
b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches (375 mm) in widest direction and 9 inches (225 mm) in narrowest would be classified as 12 inch (300 mm) stock.
c. Plants properly trimmed and transplanted should measure same in every direction.
d. Measure caliper of trees 6 inches (150 mm) above surface of ground.
e. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
f. Plant materials larger than those specified may be supplied, with prior written approval of Landscape Architect, and:
   1) If complying with Contract Document requirements in all other respects.
   2) If at no additional cost to Owner.
   3) If sizes of roots or balls are increased proportionately.

5. Shape and Form:
   a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
   b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

2.2 ACCESSORIES

A. Planting Mix:
   1. Mixture of three parts topsoil mix as specified in Section 32 9113 and one part well-rotted composted manure, or approved commercial mix.

B. Planting Tablets: (NOT APPLICABLE)

C. Tree Stakes:
   1. Type Two Acceptable Products:
      a. 2 inch (50 mm) diameter Lodgepole Pine.
      b. Equal as approved by Landscape Architect before installation.

D. Tree Staking Ties:
   1. Type Two Acceptable Products:
      a. 32 inch (800 mm) Cinch-Tie tree ties by V.I.T. Products Inc., Escondido, CA www.vitproducts.com.
      b. Flex strap Tree Ties by Aquarius Brands Inc., Ontario, CA www.aquariusbrands.com.
      c. Equal as approved by Landscape Architect before installation.

E. Tree Guys:
   1. Type Two Acceptable Products:
      a. Duckbill Model 68DTS guying kit.
      b. Equal as approved by Landscape Architect before installation.

F. Pre-Emergent Herbicide:
   1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.
      a. Chipco Dimension Granular by the Andersons Inc., Maumee, IL www.andersonsinc.com.
      b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA www.cdms.net.
      c. Ronstar G granular by Bayer Crop Science, Monheim, Germany www.bayercropscience.com.
      d. Surflan AS liquid by United Phosphorous Inc., Trenton, NJ www.upi-usa.com.

e. Oryzalin 4 A.S. liquid by Farm Saver, Seattle, WA www.farmsaver.com.

G. Weed Barrier: (NOT APPLICABLE)

H. Bark Or Wood Top Dressing Mulch:
1. One Acceptable Product:
a. Fine Bark Mulch 3/8”
b. Soil Pep
c. Equal as approved by Landscape Architect before installation.

I. Rock Mulch:
1. Type Two Acceptable Products:
a. 1.5” SOUTH TOWNE LANDSCAPE COBBLE – SOURCE: NEPHI SANDSTONE
1) Size – ¾” min. to 2” max. multicolored round
b. Equal as approved by Landscape Architect before installation.

J. Boulders:
1. Type Two Acceptable Products:
a. CHAMPLAIN BOULDERS – SOURCE: NEPHI SANDSTONE
1) Small – no less than 2’ minimum dimension on any side
2) Large – no less than 3’ minimum dimension on any side
b. Equal as approved by Landscape Architect before installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Evaluation And Assessment:
1. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with work of this Section.
2. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Drawings. All planting indicated on Drawings is required unless indicated otherwise.

3.2 PREPARATION

A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas. Secure Landscape Architect's acceptance before planting. Make minor adjustments as may be requested.

3.3 INSTALLATION

A. Interface With Other Work:
1. Do not commence work of this Section until work of Sections 32 9113 and 32-8423 have been completed and approved.

B. Excavation:
1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
2. Plant Excavation Size:
a. Diameter: Twice diameter of root ball or container minimum.

   b. Depth: Equal to container or rootball depth.
3. Unless excavated material meets topsoil requirements as specified in Section 32 9113, remove from landscape areas and do not use for landscaping purposes.
4. Roughen sides and bottoms of excavations.
5. With approval of Landscape Architect, select five typical planting excavations throughout site for drainage testing.
   a. Fill selected excavations with water and verify that water drains away at rate of 3 inches (75 mm) per hour minimum. Inform Landscape Architect in writing of excavations where water does not drain properly.
   b. Select three excavations approximately 5 feet (1 500 mm) away from each non-draining excavation and repeat tests. Continue testing process until non-draining areas have been identified.
   c. In excavations located in identified non-draining areas, auger 6 inch (150 mm) diameter hole 4 feet (1 200 mm) deep in low point of each excavation and fill with tamped planting mix.
   d. Do not plant trees or shrubs in holes that do not properly drain.

C. Planting:
1. Removing Binders And Containers:
   a. All of the wire basket and burlap shall be removed after the plant is placed in the excavation.
   b. Remove plastic and twine binders from around root ball and tree trunk.
   c. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.
2. Plant immediately after removing binding material and containers. Place tree and shrub rootballs on undisturbed soil. After watering and settling, top of tree root balls shall be approximately two inches (50 mm) higher than finished grade and trunk flare is visible. Shrub root balls shall be approximately one inch (25 mm) higher than finished grade
3. Properly cut off broken or frayed roots.
4. Center plant in hole, remove remaining wire basket, and backfill with specified planting mix. Except in heavy clay soils, make ring of mounded soil around hole perimeter to form watering basin.
5. Add planting tablets in plant pit as follows. Place tablets in relation to root ball as recommended by Manufacturer.
   a. One Gallon (4.5 L) Shrub: 1 tablet.
   b. 5 Gallon (23 L) Shrub / Tree: 3 tablets.
   c. 15 Gallon (68 L) Tree: 4 tablets.
   d. 24 inch600 mm) Box Tree: 6 Tablets.
6. Fill landscape excavations tamped planting mix. Settle by firming and watering to ensure top of ball one inch higher than surrounding soil.
7. Do not use muddy soil for backfilling.
8. Make adjustments in positions of plants as directed by Landscape Architect.
9. Thoroughly water trees and shrubs immediately after planting.
10. At base of each tree, leave 36 inch (900 mm) diameter circle free of any grass.

D. Supports for New Trees:
1. Provide new supports for trees noted on Drawings to be staked and/or approved by the Landscape Architect.
   a. Remove nursery stakes delivered with and attached to trees.
   b. Support shall consist of at least two tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet (900 mm) of stake length is below finish grade.
   c. Place tree ties 6 to 12 inches (150 to 300 mm) below crotch of main tree canopy. Second set of tree ties may be required 18 to 24 inches (450 to 600 mm) above finish grade, if directed by Landscape Architect.

d. Remove tops of tree stakes so top of stake is 6 inches (150 mm) below main tree canopy to prevent damage to tree branches and canopy growth.

2. Provide root guying kits to support 24 inch (600 mm) box, 3 inch (75 mm) caliper and larger trees.
3. Equal as approved by Owner – shop drawing and product submittal required

E. Vines:
1. Remove from stakes, untie, and securely fasten to wall or fence next to which they are planted.

F. Ground Covers:
1. Container-grown unless otherwise specified on Drawings. Space evenly to produce a uniform effect, staggered in rows and intervals shown.

G. Post Planting Weed Control:
1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
2. Areas shall be free of existing weed growth before application of herbicide.

H. Weed Barrier Fabric: (NOT APPLICABLE)

I. Mulching:
1. After application of herbicide, mulch shrub and ground cover planting areas with 1-2 inches (75 mm) deep layer of specified top dressing.
2. Cover grass-free area at tree bases with weed barrier and 1-2 inches (75 mm) of top dressing mulch.
3. In areas where rock mulch is specified – 3” minimum depth of mulch is required
4. Place mulch to uniform depth and rake to neat finished appearance.

END OF SECTION 32 9300

SECTION 33 1100

Water Utilities and Piping

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes potable water systems work.

B. Related Sections:
1. Division 31 Section "Earthwork" for excavation and backfill required for potable water systems; not work of this section.
2. Division 3 Sections for concrete work required for potable water systems; not work of this section.
3. Division 22 Section "Potable Water Systems" for interior building systems including interior piping, fixtures, and equipment; not work of this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:
1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of potable water system materials and products.
2. Water Purveyor Compliance: Comply with requirements of Purveyor supplying water to project, obtain required permits and inspections.
3. Local Regulations: Comply with governing regulations and standards of local government having jurisdiction.

1.4 SUMBITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for potable water system materials and products.

B. Maintenance Data: Submit maintenance data and parts list for potable water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Plastic Line Markers
   a. Allen Systems Inc.
   b. Seton Name Plate Corp.

c. Equal product as approved by Engineer.

2. Gate Valves:
   a. Clow Corp; Valve Div.
   b. Dresser Mfg.; Div. of Dresser Industries.
   c. Fairbanks Co.
   d. Kennedy Valve; Div. of ITT Grinnell Valve Co. Inc.
   e. Stockham Valves and Fittings Inc.
   f. Waterous Co.

2.2 IDENTIFICATION

A. Underground-Type Detectable Warning Tape (refer to Specification 31 23 00): Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".

B. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE".

2.3 PIPES AND PIPE FITTINGS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one type of materials or products are indicated, selection is Installer's option.

B. Piping: Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
   1. PVC Pipe: Schedule 40 PVC, ASTM 1785 (1-1/2" to 2" pipe diameter). AWWA Pipe: C-900 class 150 (over 2" pipe diameter).
      a. Fittings: Schedule 80 PVC fittings ASTM 1785.
   2. Copper Tube: ASTM B 88; type K, soft-annealed temper (for 3/4" to 2" diameter pipe).
   3. Ductile Iron Pipe: AWWA C151, with cement mortar lining complying with AWWA C104; Class 51 unless otherwise indicated.
      a. Fittings: Ductile-Iron complying with AWWA C110, cement lined, with rubber gaskets conforming to AWWA C111.

2.4 VALVES

A. Gate Valves: AWWA C509, resilient seated 175 psi working pressure, threaded, flanged, hub, or other end configurations to suit size of value and piping connection. Provide inside screw type for use with curb valve box, iron body, bronze-mounted, double disc, parallel seat, non-rising stem.

2.5 ACCESSORIES

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
   1. Clamps, Straps, and Washers: Steel, ASTM A 506.
   2. Rods: Steel, ASTM A 575.

3. Rod Couplings: Malleable-iron, ASTM A 197.
4. Bolts: Steel, ASTM A 307.
5. Cast-Iron Washers: Gray-iron, ASTM A 126.
6. Thrust Blocks: Concrete, 2,500 psi.
7. Yard Hydrants: Non-freeze yard hydrants, 3/4" inlet, 3/4" hose outlet, bronze casing, cast-iron or cast-aluminum casing guard, key-operated, and tapped drain port in valve housing.
8. Valve Pits: Valve pits as indicated, constructed of poured-in-place or precast concrete. Construct of dimensions indicated with manhole access, ladder, and drain. Provide sleeves for pipe entry and exit, provide waterproof sleeve seals.

2.6 METERS

A. Meters and meter boxes shall be of the local Water District standards having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF IDENTIFICATION

A. During back-filling/top-soiling of underground potable water piping, install continuous underground-type detectable warning tape (refer to Specification 02300), located directly over buried lines at 6" to 8" below finished grade.

3.3 INSTALLATION OF PIPE AND PIPE FITTINGS

A. Pipe:
1. PVC Pipe: Install in accordance with manufacturers recommendations and sand bedding as required by authority having jurisdiction.
2. Ductile Iron Pipe: Install in accordance with AWWA C600 "standard for installation of ductile-iron water mains and their appurtenances".
3. Copper Tube: Install in accordance with CDA "Copper Tube Handbook".

B. Depth of Cover: Provide minimum cover over piping of 12" below average local frost depth or 60" below finished grade, whichever is greater.

C. Water Main Connection: Arrange and pay for tap in water main, of size and in location as indicated, from water Purveyor.

D. Water Service Termination: Terminate potable water piping 5'-0" from building foundation in location and invert as indicated. Provide temporary pipe plug for piping extension into building, by work of Division 15.
1. Mark location with surface marker.

E. Runs shall be as close as possible to those shown on drawings.

F. Backfill only after pipe lines have been tested, inspected, and approved by the Architect.

3.4 INSTALLATION OF VALVES

A. Install valves with stems pointing up. Provide valve box over underground valves.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: The Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in this section. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline 24-hrs. prior to testing, and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than 200 pounds per square inch for 2-hrs.
   1. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints, irrespective of pipe diameter.
   2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.

3.6 ADJUSTING AND CLEANING

A. Disinfection of Potable Water System: Flush pipe system with clean potable water until no dirty water appears at point of outlet. Fill system with water-chlorine solution containing at least 50 ppm of chlorine. Valve off system and let stand for 24- hrs minimum. Flush with clean potable water until no chlorine remains in water coming from system.
   1. Repeat procedure if contamination is present in bacteriological examination.

B. Disinfection of Water Mains: Flush and disinfect in accordance with AWWA C652 "Standard for Disinfecting Water Mains".
   1. Contractor shall submit written verification to Project Manager stating, Disinfection has been completed in strict compliance with specification for this project and with jurisdiction having authority over water system.

END OF 33 1100

SECTION 33 1119

FIRE SUPPRESSION WATER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire water systems.

B. Related Sections:
1. Division 31 Section "Earthwork" for excavation and backfill required for fire water systems; not work of this section.
2. Refer to fire suppression sections for interior building systems including sprinklers and standpipes; this work is not included in this section.
   a. Refer to Division 21 Section Fire Suppression. Exterior water piping shall meet all requirements of this section. Test certificates are required.

1.2 QUALITY ASSURANCE

A. Codes and Standards:
1. NFPA Compliance: Install fire water systems in accordance with NFPA 24 "Standard for Installation of Private Fire Service Mains and Their Appurtenances.

B. Local Fire Department/Marshall Regulations: Comply with governing regulations pertaining to hydrants, including hose unit threading and similar matching of connections.

C. UL Compliance: Provide fire hydrants that comply with UL 246 "Hydrants for Fire-Protection Service", and are listed by UL.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for fire water system materials and products.

B. Maintenance Data: Submit maintenance data and parts lists for fire water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Acceptable manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. Line Markers:
   a. Allen Systems Inc.
   b. Seton Name Plate Corp.
   c. Equal product as approved by Architect.
2. Pipe Strainers:
   a. "Automatic" Sprinkler Corp. of America; Div. A-T-O Inc.
   b. Cleveland Gear Co.; Sub of Vesper Corp.

c. Grinnell Fire Protection Systems Co., Inc.
d. Hersey Products Inc.; Hersey Div.
e. Mueller Steam Specialty; Div. of Core Industries Inc.
f. Neptune Water Meter Co.
g. Rockwell International Corp.; Municipal & Utility Div.
h. Rockwood Systems Corp.
i. Zurn Industries Inc.; Fluid Handling Div.

3. Detector Meter:
   a. Hersey Products Inc.
4. Gate Valves:
   a. American Valve Mfg. Corp.
   b. American-Darling Valve; Div. of American Cast Iron Pipe Co.
   c. Clow Corp.; Valve Div.
   d. Fairbanks Co.
   e. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
   f. Stockham Valves & Fittings Inc.
   g. United Brass Works Inc.
   h. United States Pipe and Foundry Co.
   i. Waterous Co.
5. Check Valves:
   a. American-Darling Valve; Div. of American Cast Iron Pipe Co.
   b. Clow Corp.; Valve Corp.
   c. Fairbanks Co.
   d. Kennedy Valve; Div. of ITT Grinnell Valve Co., Inc.
   e. Mueller Co.
   f. Nibco Inc.
   g. Stockham Valves & Fittings Inc.
   h. Walworth Co.
   i. Waterous Co.
6. Fire Hydrants: As approved by authority having jurisdiction.

2.2 PIPES AND PIPE FITTINGS:

A. Provide materials and products complying with NFPA 24 where applicable. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire water piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

B. Piping: Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated. Minimum size of Fire Main serving Building Fire sprinkler system on Fire Hydrants shall be 8 inches in diameter.
   1. Ductile Iron Pipe: AWWA C151, with cement mortar lining complying with AWWA C104; Class 51 unless otherwise indicated.
      a. Fittings: Ductile-Iron complying with AWWA C110, cement lined, with rubber gaskets conforming to AWWA C111.
   2. PVC Pipe: AWWA C-900, Class 150 unless otherwise indicated.
      a. Fittings: Schedule 80 PVC fittings complying with ASTM 1785.

2.3 PIPING SPECIALTIES:

A. Pipe Line Strainers: UL-listed, 175 psi working pressure, Y-type or basket type, with ends to suit piping connections.

2.4 METERS:

A. Detector-Type Meters: UL-listed, 175 psi working pressure, with disc meter bypass.

2.5 VALVES:

A. Gate Valves: UL-listed, 175 psi working pressure for 12" and smaller, 150 psi for sizes larger than 12". Threaded, flanged, hub, or other end configurations to suit size of valve and piping connection. Inside screw type for use with indicator post, iron body bronze mounted, non- rising stem, solid wedge disc.

B. Check Valves: UL-listed, 175 psi working pressure for 2" through 12", 150 psi for sizes larger than 12". Swing type, iron body bronze mounted with metal-to-metal or rubber-faced checks. Threaded, flanged, or hub end, to suit size and piping connections.

2.6 ACCESSORIES:

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.

B. Clamps, Straps, and Washers: Steel, ASTM A 506.

C. Rods: Steel, ASTM A 575.

D. Rod Couplings: Malleable-iron, ASTM A 197.

E. Bolts: Steel, ASTM A 307.

F. Cast-Iron Washers: Gray-iron, ASTM A 126.

G. Thrust Blocks: Concrete, 2,500 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification: During back-filling/top-soiling of underground fire water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade.

B. Pipe and pipe fittings:
1. Ductile-Iron Pipe: Install in accordance with AWWA C600 "Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances".

2. PVC Pipe: Install in accordance with manufacturers recommendations and provide pipe bedding as required by authority having jurisdiction.

C. Piping Specialties:

1. Pipe Line Strainers: Install as indicated, with valved blowoff piped to drain.

D. Meters: Install as indicated with shutoff valve on either side of meter and valved bypass full line size.

E. Valves: Provide post indicator for control valves.
1. Shutoff Valves: Install shutoff valve ahead of each hydrant.

F. Runs shall be as close as possible to those shown on drawings.

3.2 FIELD QUALITY CONTROL:

A. Testing Agency: The Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in this section. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Piping Tests: Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline with water 24-hrs prior to testing, and apply test pressure to stabilize system.

C. Hydrostatic Tests: Test at not less than 200 psi for 2-hrs, or at 50 psi above maximum static pressure if it is greater than 150 psi.
1. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints irrespective of pipe diameter.
2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.

D. Operating Tests: Open and close all valves and hydrants under system water pressure. Check dry barrel hydrants for proper drainage.
1. For systems with fire pumps, run pumps during operating tests.

3.3 ADJUSTING AND CLEANING:

A. Flushing: Flush underground mains and lead-in connections to sprinkler risers before connection is made to sprinklers, standpipes, or other fire protection system piping.
1. Flush at flow rate not less than that indicated in NFPA 24, or at hydraulically calculated water demand rate of the system, whichever is greater.

B. Disinfection of Potable Water System: Flush pipe system with clean potable water until no dirty water appears at point of outlet. Fill system with water-chlorine solution containing at least 50 ppm of chlorine. Valve off system and let stand for 24- hrs minimum. Flush with clean potable water until no chlorine remains in water coming from system.
1. Repeat procedure if contamination is present in bacteriological examination.

C. Disinfection of Water Mains: Flush and disinfect in accordance with AWWA C652 "Standard for Disinfecting Water Mains".
1. Contractor shall submit written verification to Project Manager stating, Disinfection has been completed in strict compliance with specification for this project and with jurisdiction having authority over water system

END OF SECTION 331119

SECTION 33 3100

SANITARY SEWAGE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY.

A. Section includes sanitary sewage systems.

B. Related Sections:
1. Refer to Division 31 section "Earthwork" for excavation and backfill required for sanitary sewage systems; not work of this section.
2. Refer to Division 22 section "Soil and Waste Systems" for interior building systems including drain, waste, and vent piping; not work of this section.

1.2 QUALITY ASSURANCE:

A. Codes and Standards:
1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of sanitary sewage system materials and products.
2. Local Regulations: Comply with governing regulations and standards of local government having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

A. Acceptable Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Line Markers:
   a. Allen Systems, Inc.
   b. Emed Co., Inc.
   c. Seton Name Plate Corp.

2.2 IDENTIFICATION:

A. Underground-Type Detectable Warning Tape (refer to Specification 02300): Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SEWER LINE BURIED BELOW".

2.3 PIPES AND PIPE FITTINGS:

A. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
1. Cast-Iron Soil Pipe: ASTM A 74, hub and spigot ends, service weight unless otherwise indicated.
   a. Fittings: Cast-iron hub and spigot ends, standard strength unless otherwise indicated.

2. Concrete Pipe: ASTM C 14, Class III non-reinforced concrete pipe, unless otherwise indicated.
   a. Fittings: Concrete, same strength as adjoining pipe, tongue and groove gasketed joints complying with ASTM C 443.
3. Polyvinyl Chloride (PVC) Sewer Pipe: ASTM D 3034, Type PSM, SDR 35.
   a. Fittings: ASTM 3034, bell and spigot joints.

2.4 SANITARY SEWER MANHOLES:

A. Provide precast reinforced concrete sanitary manholes as indicated, and complying with ASTM C 478.
   1. Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
   2. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.
   3. Steps: Ductile-iron or aluminum, integrally cast into manhole sidewalls.
   4. Frame and Cover: Ductile-iron, 21-3/4" diameter cover, heavy-duty, indented top design, with lettering cast into top reading "SANITARY SEWER".
   5. Pipe Connectors: Resilient, complying with ASTM C 923.

2.5 CLEANOUTS:

A. Pipe extension to grade with ferrule and countersunk cleanout plug. Round cast-iron access frame over cleanout, with heavy-duty secured scoriated cover with lifting device.

PART 3 - EXECUTION

3.1 INSTALLATION OF IDENTIFICATION:

A. During back-filling/top-soiling of sanitary sewage systems, install continuous underground-type detectable warning tape, located directly over buried line at 6" to 8" below finished grade.

3.2 INSTALLATION OF PIPE AND FITTINGS:

A. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
   1. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
   2. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
   3. Place bell ends or groove ends of piping facing upstream.
   4. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
   5. Runs shall be as close as possible to those shown on drawings.

B. Pipe:
   1. Cast-Iron Pipe: Install in accordance with applicable provisions of CISPI "Cast Iron Soil Pipe and Fittings Handbook".
   2. Concrete Pipe: Install in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual".
   3. Plastic Pipe: Install in accordance with manufacturer's installation recommendations, and in accordance with ASTM D 2321.

C. Cleaning Pipe: Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.
   1. In large, accessible piping, brushes and brooms may be used for cleaning.
   2. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
   3. Flush lines between manholes if required to remove collected debris.

D. Joint Adapters: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

E. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
   1. Make inspections after lines between manholes, or manhole locations, have been installed and approximately 2-ft of backfill is in place, and again at completion of project.
   2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects, and reinspect.

3.3 SANITARY MANHOLES:

A. Place precast concrete sections as indicated. Where manholes occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops 3" above finish surface, unless otherwise indicated.
   1. Install in accordance with ASTM C 891.
   2. Apply bituminous mastic coating at joints of sections.

3.4 TAP CONNECTIONS:

A. Make connections to existing piping and underground structures, so that finished work will conform as nearly as practicable to requirements specified for new work.

B. Use commercially manufactured wyes for branch connections. Field cutting into piping will not be permitted. Spring wyes into existing line and encase entire wye, plus 6" overlap, with not less than 6" of 4,000 psi 28-day compressive strength concrete.

C. Take care while making tap connections to prevent concrete or debris from entering existing piping or structure. Remove debris, concrete, or other extraneous material which may accumulate.

3.5 BACKFILLING:

A. Conduct backfilling operations of open-cut trenches closely following laying, jointing, and bedding or pipe, and after initial inspection and testing are completed.

3.6 FIELD QUALITY CONTROL:

A. Testing Agency: The Owner will employ and pay a qualified independent testing agency to perform field quality-control testing services specified in this section. Retesting of materials failing to meet specified requirements shall be done at Contractor’s expense.

B. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.

END OF DOCUMENT 33 3100

SECTION 33 4100

STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes storm drainage outside the building.

B. Related Sections include the following:
   1. Refer to Division-2 Section "Earthwork" for excavation and backfill required for storm drainage systems; not work of this section.
   2. Refer to Division-2 sections for concrete work required for storm drainage systems; not work of this section.
   3. Refer to Division-22 section "Plumbing Piping" for interior building systems including connections to roof and deck drains; not work of this section.

1.3 PROJECT CONDITIONS

A. Site Information: Perform site survey, and verify existing utility locations.

B. Existing Structures: Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Architect's written permission.

1.4 QUALITY ASSURANCE

A. Codes and Standards:
   1. Local Regulations: Comply with governing regulations and standards of local City having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Stormwater Disposal Systems:
      a. Advanced Drainage Systems, Inc.
      b. Cultec, Inc.

c. Hancor, Inc.
d. Infiltrator Systems, Inc.
e. PSA, Inc.

2.2 PIPES AND FITTINGS

A. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

B. Corrugated PE Drainage Tubing and Fittings: AASHTO M 252, Type S, with smooth waterway for coupling joints.
1. Soiltight Couplings: AASHTO M 252, corrugated, matching tube and fittings to form soiltight joints.

C. Corrugated PE Pipe and Fittings: AASHTO M 294, Type S, with smooth waterway for coupling joints.
1. Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings to form soiltight joints.

D. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M), Class III, Wall B, for gasketed joints.
1. Gaskets: ASTM C 443 (ASTM C 443M), rubber.

E. Polyvinyl Chloride (PVC) Sewer Pipe: ASTM D 3034, Type PSM, SDR 35.
1. Fittings: ASTM 3034, bell and spigot joints. 12" diameter and smaller.

2.3 MANHOLES

A. Provide precast reinforced concrete storm drain manholes as indicated, complying with ASTM C 478.
1. Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
2. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.
3. Steps: Ductile-iron or aluminum, integrally cast into manhole sidewalls.
4. Frame and Cover: Ductile-iron, 21-3/4" diameter cover, heavy-duty, indented top design, with lettering cast into top reading "STORM SEWER", conforming to ASTM A-48, unless otherwise specified on the plans.
5. Pipe Connections: Resilient, complying with ASTM C 923.

2.4 CATCH BASINS

A. Precast or cast in place reinforced concrete catch basins as indicated.
1. Basin: Precast or cast in place reinforced concrete, flat slab top.
2. Frame and Grate: Ductile-iron or galvanized steel grate, heavy- duty, bicycle proof.
3. Pipe Connectors: Resilient, complying with ASTM C 923.

2.5 PIPE OUTLETS

A. Head Walls: Amcor CP190 Precast Flared End Section or Equivalent.

B. Riprap Basins: Broken, irregular size and shape, graded stone.
1. Average Size: NSA No. R-5, screen opening 5 inches (127 mm).

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. PE Pipe and Fittings: As follows:
   1. Join pipe, tubing, and fittings with couplings for soiltight joints according to manufacturer's written instructions.
   2. Install according to ASTM D 2321 and manufacturer's written instructions.
   3. Install corrugated piping according to the Corrugated Polyethylene Pipe Association's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

C. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
   1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets.

3.4 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

3.5 CATCH-BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 STORM DRAINAGE OUTLET INSTALLATION

A. Construct riprap of broken stone, as indicated.

B. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.7 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

B. Fasten grates to drains if indicated.

C. Set drain frames and covers with tops flush with pavement surface.

3.8 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
   1. In large, accessible piping, brushes and brooms may be used for cleaning.
   2. Place plug in end of incomplete piping at end of day and when work stops.
   3. Flush piping between manholes and other structures to remove collected debris.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) f backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Crushed, broken, cracked, or otherwise damaged piping.
      c. Infiltration: Water leakage into piping.
      d. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

END OF SECTION 33 4100