ISSUED FOR BID

SPECIFICATIONS FOR:

2027 MECHANICAL IMPROVEMENTS PROJECT – PHASE 3

EAST AURORA HIGH SCHOOL

500 TOMCAT LANE

AURORA, IL 60506

OWNER:

EAST AURORA SCHOOL DISTRICT #131

310 SEMINARY AVENUE
AURORA, IL 60505

PREPARED BY:

CORDOGAN CLARK & ASSOCIATES INC.

PROJECT NUMBERS: 261012

DATED: OCTOBER 2026

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

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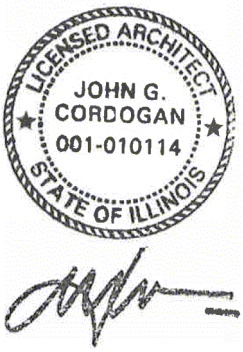
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CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:
   1. John G. Cordogan
   2. 001-010114
   3. Responsible for all divisions except where indicated as prepared by other design professionals of record.



END OF DOCUMENT 000107

SECTION 002000 – NOTICE TO BIDDERS

A. East Aurora School District (hereinafter referred to as the Owner) will receive bids for the following projects until 10:00 A.M., local time, on October 22, 2026, at the District Office of East Aurora School District #131, 310 Seminary Avenue, Aurora, IL 60506:

Base Bid - Project #261012– East Aurora High School – 2027 Mechanical Improvements

B. Bids will be publicly opened and read at the time and location noted above.

C. A public advertisement was posted on October 30, 2026.

D. **This will be a Mechanical Prime Bid**; The bidding General Contractors' principal business shall be in Heating, Ventilation, and Air Conditioning. All Mechanical Prime Contractors will be required to subcontract with a General Contractor to coordinate project schedule, communications, and general project coordination.

E. Contract Documents may be obtained by Bidding Contractors from Vesco Reprographics 630-896-2115 or http://www.cordoganclarkplanroom.com, on or after, October 1, 2026.

F. All bids must be accompanied by a Bid Security in the form of Bid Bond in the amount of 10% of the Base Bid (plus additive alternates) made payable to the Owner.

G. A mandatory pre-bid conference will be conducted remotely via Microsoft Teams on October 5, 2026, at 10:00 am. See Section 002513 "Prebid Meetings" for additional information.

H. Following the pre-bid conference, walk-throughs will be held on the following dates: October 6th, 2026 at 7:30am, October 9th, 2026 at 9:30am & October 12th, 2026 at 11:00am. Contractors are required to visit the site. Site walk-throughs will meet on site at DOOR #1 at times and dates listed above.

Adress: East Aurora High School, 500 Tomcat Lane, Aurora, IL 60505.

I. For site access after the pre-bid meeting, contact Luca Muench lmuench@cordoganclark.com

J. All bidders are required to visit the site. All contractors shall visit the site and become familiar with all existing conditions prior to submitting the final bid. If there are any discrepancies, notify the architect at once. The project site is available for inspection by appointment only after the mandatory pre-bid meeting.

K. The Contractor shall pay, if applicable, not less than the prevailing rate of wages as established, to all laborers, workmen and mechanics in the performance of Work under this Contract in accordance with "An Act regulating wages of laborers, mechanics and other employed under

contracts of Public Works." 820 ILCS 130/1 et seq.

L. The Owner reserves the right to reject any and all bids, to waive any informality in bidding, or accept the bid that, in his opinion, will serve his best interests.

M. This Notice is written in the name of the Owner by Cordogan, Clark & Associates.

END OF NOTICE TO BIDDERS

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

DOCUMENT 002513 - PREBID MEETINGS

1.1 PREBID MEETING

A. Architect will conduct a Prebid meeting as indicated below:

1. Meeting Date: October 5, 2026.
2. Meeting Time: 10:00 a.m., local time.
3. The meeting will be conducted remotely via Microsoft Teams. Microsoft Teams can be downloaded here: https://teams.microsoft.com/downloads

B. Attendance: **Bidders please send the architect an email address to be used for the video conference pre-bid meeting**. Send email addresses to: constructionadminaurora@cordoganclark.com

Once the architect receives the email, an invitation to a Microsoft Teams meeting will be sent to that email address. This will allow the bidder to electronically access the meeting via phone or computer. **Microsoft Teams Meeting: The call in number is 1-708-298-4485, Conference ID 657 252 291#**

1. Prime Bidders: Attendance at Prebid meeting is **mandatory**.
2. Subcontractors: Attendance at Prebid meeting is **recommended**.
3. Notice: Bids will only be accepted from prime bidders represented on Prebid Meeting sign-in sheet.

C. Bidder Questions: Submit written questions to be addressed at Prebid meeting minimum of two business days prior to meeting.

D. Agenda: Prebid meeting agenda will include review of topics that may affect proper preparation and submittal of bids, including the following:

1. Procurement and Contracting Requirements:

a. Advertisement for Bids.
b. Bidder Qualifications.
c. Bonding.
d. Insurance.
e. Bid Security.
f. Bid Form and Attachments.
g. Bid Submittal Requirements.
h. Bid Submittal Checklist.
i. Critical Path Method schedule
j. Notice of Award.

2. Communication during Bidding Period:

    a. Obtaining documents.
    b. Access to Project Web site.
    c. Bidder's Requests for Information.
    d. Bidder's Substitution Request/Prior Approval Request.
    e. Addenda.

3. Contracting Requirements:

    a. Agreement.
    b. The General Conditions.
    c. The Supplementary Conditions.
    d. Other Owner requirements.

4. Construction Documents:

    a. Scopes of Work.
    b. Temporary Facilities.
    c. Use of Site.
    d. Work Restrictions.
    e. Alternates, Allowances, and Unit Prices.
    f. Substitutions following award.

5. Separate Contracts:

    a. Work by Owner.
    b. Work of Other Contracts.

6. Schedule:

    a. Project Schedule.
    b. Contract Time.
    c. Other Bidder Questions.

7. Site/facility visit or walkthrough.
8. Post-Meeting Addendum.

E. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes to attendees. Minutes of meeting are issued as Available Information and do not constitute a modification to the Procurement and Contracting Documents. Modifications to the Procurement and Contracting Documents are issued by written Addendum only.

    1. Sign-in Sheet: Minutes will include list of meeting attendees.
    2. List of Plan holders: Minutes will include list of plan holders.

END OF DOCUMENT 002513

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

SECTION 003000 - INSTRUCTION TO BIDDERS

PART 1 - GENERAL

1.1 SUMMARY

Single lump sum proposal will be received to construct the projects in accordance with the bid package(s), drawings, specifications, and project manuals prepared by Cordogan, Clark & Associates, and all other applicable contract documents.

Owner: East Aurora School District 131

Architect/Engineer CCA – Cordogan Clark & Associates

** Contractor's bid proposal is to include the use of Autodesk Build for all project submittal processes including but not limited to schedules, RFI's, CO's, product data submittals, etc.as defined in the Form of Proposal.

1.2 QUALIFICATION REQUIREMENTS

Contractors are required to submit qualifications with their proposal. Proposals will be evaluated and awarded based on proposals received by qualified contractors. See the attached exhibits for required qualification documentation and the proposal award. Although price is a major consideration in the award of the bid, the Client may consider and base the award on other factors, including, but not limited to the following:

1. The ability, capacity and skill of the Bidder to perform services or provide the goods required.
2. Whether the Bidder can perform the contract or provide the service promptly, or within the time specified, without delay or interference.
3. The character, integrity, reputations, judgment, experience and efficiency of the Bidder.
4. The quality of performance of previous contracts or services.
5. The previous and existing compliance by the Bidder with laws and ordinances relating to the contract or service.
6. The sufficiency of the financial resources and ability of the Bidder to perform the contract or provide the service.
7. The quality, availability and adaptability of the supplies, or services to the particular use required by the Owner.
8. The ability to achieve or exceed any LEED requirements that may be set forth within the bidding documents.
9. EASD 131 requires finger printing and background checks for all Contractors working in the School District.
10. The Contractor must certify to the Illinois Department of Human Rights that provisions have been made regarding discrimination-free workplace, as well as certifications for drug-free workplace.

11. A scope meeting with the apparent low Bidder/Bidders will be held after the bid opening, personnel knowledgeable about the project scope will be required to be available by phone or Microsoft Teams after 10:30 am on October 23th – October 28st , 2026, to discuss the project scope. The bidding Contractor must have the following selected contractors/ subcontractors in the meeting, General Contractor, Steel Erector, Mechanical Piping Contractor, Mechanical Ventilation Contractor, and the Electrical Contractor. Post-Bid interview times are as follows (times may change, and additional interviews may be added):

    a. Apparent Low Bidder: October 23th , 2026, between the hours of 1:00 pm - 4:30 pm and will be conducted remotely via Microsoft Teams.

    b. Apparent Second Low Bidder: October 23st , 2026, between the hours of 1:00 pm - 4:30 pm and will be conducted remotely via Microsoft Teams.

1.3 SUBMISSION OF BIDS

Proposals shall be made in accordance with the following instructions. Proposals shall be delivered on or before 10:00 A.M., local time, on October 22th , 2026. Any bids received after this time may be rejected. Proposals must be made upon the form provided within and shall be addressed to:

East Aurora School District #131
310 Seminary Avenue
Aurora, IL 60505
Attention: Ashraf Kawash, Director of Buildings & Grounds

The envelope shall be plainly marked:

East Aurora School District #131
Project: East Aurora High School 2026 Mechanical Improvements
Do Not Open –Project # 261012

1.4 AVAILABILITY OF DOCUMENTS:

Bid Package documents, drawings, and specifications shall be distributed electronically by the Architect on or after October 1, 2026. Bidders may also contact the following reprographic provider to obtain the bid documents. Printing and shipping costs shall be the responsibility of the Bidder:

Vesco Reprographic
1351 Aucutt Road
Montgomery, IL 60538
630.896.2115 tel.
630.897.6434 fax.
http://www.cordoganclarkplanroom.com

Upon receipt of the Bid Package the Bidder shall immediately check that all documents listed in item 1.7 of these instructions have been received. If any section is missing, contact the Architect immediately.

1.5 PRE-BID CONFERENCE:

A. A mandatory pre-bid conference will be conducted remotely via Microsoft Teams on October 5th, 2026, at 10:00 am. See Section 002513 "Prebid Meetings" for additional information regarding the meeting.

B. Following the pre-bid conference, walk-throughs will be held on the following dates: October 6th, 2026 at 7:30am, October 9th, 2026 at 9:30am & October 12th, 2026 at 11:00am. Contractors are required to visit the site. Site walk-throughs will meet on site at DOOR #1 at times and dates listed above.

Adress: East Aurora High School, 500 Tomcat Lane, Aurora, IL 60505.

For site access after the pre-bid walk throughs, contact Luca Muench: lmuench@cordoganclark.com

1.6 SUBMISSION OF PROPOSAL

A. The bidder shall submit the proposal form provided which shall be filled out completely and addressed to the above address. On the outside of the bid envelope, each sealed bid shall also contain the notation “SEALED BID” along with the following information:

1. Project Name
2. Bidders Company Name and Address
3. Date and Time of Bid Opening, (local time).

B. Each Bid submission shall contain two sets of the following in the order listed below:

1. Exhibit E: Bid Bond – ONE ORIGINAL AND ONE DUPLICATE
2. Section 004000 Form of Proposal – COMPLETE AND IN DUPLICATE
3. Section 003500 Requirements for Qualification (with supporting documents) – COMPLETE AND IN DUPLICATE
4. Preliminary Construction Schedules – Provide a Critical Path Method schedule outlining Major and Minor schedule milestones, as well as a plan indicating where work will occur with start and finish dates to complete the project as indicated in Preliminary Schedules. Provide a schedule for the school. – COMPLETE AND IN DUPLICATE
5. Bid Clarification Summary – COMPLETE AND IN DUPLICATE

C. A Schedule of Values is included as part of the Bid Form. The prices given in this Schedule are intended solely for the purpose of evaluating the bid. (*Although the Schedule of Values in some instances includes unit quantities, these projects are to be bid as a lump sum*.) The bidders are responsible for verifying their own quantities for bidding purposes. The bid shall be for an installed and complete project as drawn and specified. **A completed schedule of values must be submitted as part of the bid submission.**

D. If the Schedule of Values includes any allowances, each bidder should include this amount in the lump sum bid.

Proposals shall be presented to the Owner for approval of selected contractors. Proposals may be rejected by the Owner as informal, unless properly signed in longhand by the Bidder, or his authorized agent, and unless all dates, items and amounts called for in the Form of Proposal are furnished. Proposals which are

not signed by the individual making them should have attached thereto, a Power of Attorney, evidencing authority to sign the Proposal in the name of the person for whom it is signed. Proposals which are signed for a Partnership should be signed in the Firm name by required number of Partners to bind, or in the Firm name by an Attorney-in-Fact. Proposals which are signed for a Corporation should have the correct corporate name thereof and the signature of the President or other authorized officer of the Corporation in longhand. If such proposal is signed by an official other than the President, authority of such to sign the attesting signature of the Secretary of the Corporation and the impression of the Corporate Seal.

Proposals will also be considered informal if the Form of Proposal contains any erasures or written memoranda qualifying the same. Any explanation or statement which the Bidder wishes to make must be placed in the same envelope with the proposal but shall be written separately and independently and attached thereto. The Owner reserves the right to waive any or all irregularities or informalities. Proposals may be withdrawn on written or telegraphic requests received from Bidders prior to the time fixed for opening of bids. Negligence on the part of the Bidders in preparing their proposal confers no right for the withdrawal of the proposal after it has been opened.

The Owner reserves the right to (1) reject all bids; (2) reject only certain bids which are non-conforming or non-responsive to the bid requirements; (3) accept only a portion, part or specific items of work of all bids which are separately set forth on the bid proposal form and reject others; (4) add additional work items based on either schedule of value bid breakdown pricing or unit pricing set forth on the bid proposal form, as the Owner shall in its sole discretion determine to be in its best interests, and to award the contract to the responsible Bidder submitting the lowest bid responsive to the bidding requirements. In the event of a rejection of a portion, part, or certain items of work, the bid of each Bidder shall automatically be deemed reduced by the amount of such rejected part or item at the unit price or other cost designated therefore by that Bidder on its submitted bid. The Owner shall have the right to accept Alternatives in any order or combination and to determine the low Bidder on the basis of the sum of the Base Bid, Voluntary Alternates, and Alternates accepted.

The Owner reserves the right to accept any and all bids and to permit corrections of any obvious and apparent errors in bidding. The Owner reserves the right to review the references of past performances of all Contractors to be used in the project. The Owner reserves the right to review these references and other materials and accept or reject any or all Contractors. It is agreed that this bid may not be withdrawn for a period of ninety (90) days from the submittal thereof.

It is neither the intent nor the purpose of these specifications to prohibit a reliable Bidder from bidding or securing a contract for the proposed goods/services. However, the documents do outline the requirements for the goods/services best suited to the needs of the Owner. Exceptions to these specifications will be considered only as voluntary alternates. Each Bidder whose proposal cannot conform to these specifications shall list in detail all exceptions or alternates to the attached specifications in the voluntary alternates section of the bid form. The acceptance of such exceptions or alternates shall, however, be judged solely within the discretion of the Owner.

Purchases of building material for incorporation into this project are exempt for the Illinois Retailer's Occupation Tax and Use Tax (Sales Tax). The Owner's Tax-Exempt Number is E9984-4184-06. The Bidder shall exclude such taxes from consideration in preparing his bid. Proposals shall be presented to the East Aurora School District #131 Board of Education for approval of the selected contractor on November 16, 2026. Contracts will be awarded upon approval by the Board.

1.7 EXAMINATION OF SITE AND CONDITIONS OF CONTRACT

Before submitting a proposal, each Bidder shall inform himself of the conditions under which the work is to be performed, the site of the work, the obstacles which may be encountered and all other relevant matters concerning the work to be performed. Also, the Bidder, if awarded the contract, shall not be allowed any extra compensation by reason of any matter or thing concerning which such Bidder might have fully informed himself prior to the bidding. Any additional visits will be limited and need to be schedule with the district. Lack of additional site access shall not relieve the Bidder responsibility of the conditions under which the work is to be performed.

By submitting a proposal, each Bidder agrees the Contract Documents have been examined, the site has been visited - including visits by major subcontractors, all project conditions and limitations affecting the work have been noted and understands the nature of the work, general and local conditions, and accepts the contract as the form of the Contract Agreement between the Contractor and the Owner. The successful bidder's Contract Agreement may be assigned to the Construction Manager or the General Trades prime contractor. By submitting a bid, the successful Bidder consents to this assignment. Include all costs related to your work affected by these conditions. No proposal will be entertained which is not based upon the complete Contract Documents consisting of the following:

Specifications & Exhibits
Form of Proposal Documents
Requirements for Qualification Documents
Accompanying Drawings
Addenda, if any

Any written instructions in the Form of Addenda issued during the bidding period are to be included in the proposal and will become part of the Contract Documents.

1.8 PERMITS & LICENSES

Successful Bidders shall be responsible for all necessary permits, licenses and fees associated with their work. The Owner will obtain the building permit only. All Bidders and their Subcontractor(s) must be licensed with all entities having jurisdiction and shall obtain all required building permits prior to the start of any work. Any additional permits or fees required to perform the work shall be the responsibility of the performing trade.

1.9 BONDING

All Bidders shall be required to furnish a Bid Bond in the amount of Ten Percent (10%) of the Contractor's proposed cost of construction. The Bid Bond shall be required at the time of submittal of proposal. No proposal will be entertained which is not accompanied by a Bid Bond.

The successful Bidder will be required to furnish a Performance and Payment Bond in the full amount of the Contract executed on A.I.A. Form A-312, "Performance Bond and labor and Material Payment Bond" prior to the start of any work. The Performance Bond shall: 1) serve as security for faithful performance of the work; and 2) guarantee the work against defective workmanship and material for a period of not less than one (1) year following acceptance of the work.

The Labor and Material Bond shall serve as security that all wages are paid and materials provided for the work are paid by the successful Bidder. For Contract awards that are less than $50,000.00, a Letter of Credit, in a form suitable to the Owner, may be submitted as performance security, instead of a Performance Bond and a Labor and Material Payment Bond. The Surety is to be approved by the Owner. The Contractor will pay for the cost of all Bonds. All Bids shall include cost of Performance and Payment Bonds.

1.10 TIME SCHEDULE

Contractor is required to perform their work within the following provided Milestone Schedules. The Construction Manager shall anticipate an aggressive construction operation. By submitting a Bid each Contractor guarantees they can meet the proposed Construction Schedule. Contractor shall assume multiple mobilizations may be required to perform their scope of work. All Bids shall include costs for the same. Substantial Completion Time Schedule:

Refer to Exhibits L - Milestone Schedule

1. The building is accessible from 3:30 pm to 10:00 pm after November 17th, 2026 for Mechanical Contractor for equipment verification.
2. Building is accessible during Spring Break, March 29th – April 2rd , 2027, for work not impacting school activities.
3. April 15th - 30th, 2027, Boiler Room Abatement.
4. May 31st, 2027 – Contractor access to non-abatement areas
5. June 7th - 10th, 2027, Remaining abatement.
6. June 21-July 2, 2027 – Contractor access to Server Room 111 & 111A

1. All areas of the facilities that are impacted by these projects and will be occupied by students or staff are to be provided with ventilation and space conditioning approved by code and the Kane County ROE, whether provided by that facility's mechanical system or temporary equipment, before staff and students occupy the building. The spaces must be cleaned and prepared for staff access/ move in on the scheduled District Move in date on the Milestone schedule, August 4th, 2027. Contractor is to provide a Critical Path Method schedule outlining Major and Minor schedule milestones, as well as, a plan indicating where work will occur with start and finish dates to complete the project as indicated in Preliminary Schedules at each school as part of the bid response. If an act of God occurs affecting the arrival of equipment and or materials, the General contractor shall provide an updated schedule immediately showing the sequences it affects. The project schedule should not extend further then the time of the delay. All items not affected by this act are expected to move forward per the original schedule and potentially be moved ahead of schedule when possible. Deviations from the preliminary schedule above maybe acceptable but must be identified in the submitted schedule as part of the bid form. Failure to do so is grounds for determination of a non-conforming bid.

1.11 LIQUIDATED DAMAGES

The Owner or Architect is not to be held responsible for any damages incurred by the Contractor through the fault of any other contractor employed by the Owner. If the Contractor fails to deliver his materials in accordance with the completion schedule or as the progress of the work requires all expenses which are incurred in expediting the shipment of materials shall be paid for by the Contractor.

Failure to complete the Work on the dates set forth will result in significant economic losses to the Owner. Contractor agrees to perform the Work fully, and in all things, execute and finally complete the Work before the scheduled dates as set forth.

1. The mechanical contractor will coordinate with Trane and the Mechanical Engineer regarding equipment configuration items, such as coil hand, etc. This must be completed and submitted by **January 8th, 2027**. Should the Contractor fail to complete the equipment selection submittal Work within such time a Liquidated damage fee of $5,000 for each day of such delay will be assessed.
2. Should the Contractor fail to complete the Projects by the substantial completion dates, the Contractor agrees to pay and will apply to the Owner for each and every day of such delay in completion of the Work beyond the dates set forth, the sum of $500.00 per space as Liquidated Damages.
3. The district networking infrastructure located in rooms 111 and 111A in Area C must not be disturbed as a result of the construction process. If any construction activities damage any of the district's networking equipment or disrupt the functionality of any of the district's processes occurring in these rooms, the contractor agrees to pay the owner the sum of $8,000 per day as liquidated damages until the functionality originally present in the room has been restored. Liquidated Damages may apply if the scheduled dates listed in the previous section are not met.

The Contractor acknowledges the difficulty in estimating the damages for loss of use but agrees that the amount set forth herein is a reasonable approximation of the Owner's loss due to loss of use per them of the property. The Contractor agrees that this amount is not a penalty. Such sum shall be deducted from the final payment due to Contractor. Should this amount exceed the sum due or to become due to the Contractor, then and in that event, Contractor shall be liable to Owner for such difference. The Contractor shall reimburse the Owner for all Architect, Construction Management and/or Project Management fees for additional services necessitated by Contractor's failure to reach Substantial Completion within the time estimated in the Agreement and for more than one inspection for each Substantial Completion/Final Completion.

1.12 CHANGE ORDERS

The successful Bidder shall be required to follow the Owner's guidelines for Change Order mark-ups, namely that any Change Order proposal submitted to the Architect for an increase to the Contract Sum shall be limited to a maximum of five percent (5%) of the cost of the additional materials and labor for the general conditions and profit of the Contract. This includes any increase to the Performance Bond and Labor and Material Payment Bonds. The Performance Bond and Labor and Material Payment Bonds are considered part of the General condition's costs.

1.13 SAFETY REQUIREMENTS

All Contractors and Subcontractors of any tier will be required to comply with the provisions of the "Construction Safety Act" and the "Occupational Safety and Health Act of 1970", the General conditions, as well as all other applicable Federal, State, and local requirement. Each Contractor shall be responsible for the payment of all fines levied against the Owner, Architect/Engineer, or Construction Manager for deficiencies relating to the safety of the Contractor's work.

1.14 STATUTORY REQUIREMENTS

All applicable Federal and State laws, and the rules and regulations of all authorities having jurisdiction over construction of the project, shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though written therein in full. This includes all current regulations with respect to paying the prevailing wage, which shall be incorporated into this project. To access Kane County prevailing wage rates, visit the State of Illinois' Department of Labor website at https://www2.illinois.gov/idol. Not less than the Prevailing Wages as found by the Department of Labor or determined by the court on review shall be paid to laborers, workmen, and mechanics performing work under this contract.

By submitting a Bid, Bidders and all Subcontractors they employ, certify that each of them shall provide and maintain a drug free work place and Drug Free Workplace Program as described in Section 3 of the Drug Free Workplace Act, 30 ILCS 580/1.

Public Act 094-0515 requires the successful Contractor submit a certified payroll to the Owner on a monthly basis for the contracts they have been awarded. All Contractors shall submit monthly certified payroll reports to the Owner. No payment requests will be processed without certified payroll reports.

All Contractors are required to submit in triplicate the following on a monthly basis as scheduled and outlined in Specification Section 012900 – Payment Procedures: AIA G702 cover page & AIA G703 continuation sheets, partial lien waivers for the full amount of the total current completed amount, trailing lien waivers for all suppliers and Subcontractors, and certified payroll reports for the current billing period.

1.15 ADDITIONAL INFORMATION

Copies of AIA standard forms may be obtained from the American Institute of Architects; http://www.aia.org/contractdocs/purchase/index.htm; docspurchases@aia.org (800) 942-7732.

The successful Bidder shall be required to complete all required progress documentation including Regional Office of Education (ROE) Called Inspection Reports as included in the Exhibits of the specifications.

The Bidder shall, in the event of any discrepancies, omissions, or errors in the Contract Documents, or in the event of doubt on the part of a Bidder as to their intent or meaning, direct inquiries in writing to: Attention: Cordogan, Clark & Associates, Inc., constructionadminaurora@cordoganclark.com. All questions relating to specific scope responsibility or other construction related activity shall be addressed to the same. No inquiries shall be reviewed or accepted 72 hours prior to Bid opening. No extras shall be accepted on this project unless initiated by the Owner. Discrepancies, exclusions, clarification regarding each Subcontractor's scope of work shall be addressed by Subcontractor, in writing, to the Construction Manager during the Bidding process.

END OF SECTION 003000

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678
OCTOBER 2026

SECTION 003500 – REQUIREMENTS FOR QUALIFICATION

1.1 PURPOSE, LAWS, AND REGULATIONS

A. The purpose of the Qualification Procedure described in this Document is to provide Owner with a mechanism to evaluate and determine whether Bidders are qualified to participate in the construction of the Project.

B. Applicable provisions of all state and local entities having authority shall be observed in the soliciting, receiving, and evaluating of Bidders' qualifications. Applicable provisions shall be observed in bidding, letting, and execution of the Work.

C. Prospective Bidders are required to comply with these Requirements for Qualification. Only those Bidders who have complied with the Requirements for Qualification and have been determined to be qualified will be eligible for acceptance of construction bids on the Project.

1.2 DEFINITIONS

A. Financial Statement: The requirement for submitting a financial statement as an attachment to AIA Document A305, "Contractor's Qualification Statement" shall be understood to mean a certified annual audit, prepared according to generally acceptable accounting practices and signed by an independent certified public accountant. A Reviewed Statement of Assets and Liabilities, prepared and signed by an independent certified public accountant, is also acceptable. A self-prepared annual compiled financial statement or balance sheet is unacceptable.

B. Bidder: A Bidder is a person or entity who submits a Submittal of Qualifications to Owner included with their bid documents.

C. Project: Generally described in the Invitation to Bidders and/or the Advertisement for Bids.

1.3 QUALIFICATION DOCUMENTS

A. Qualification Documents: Consist of the following:

1. Section 1.9 “Relevant Experience Verification Form” contained within this Requirements for Qualifications specification section;
2. Cordogan Clark & Associates Contractor Pre-Qualification Form; (See Exhibit’s Section)
3. AIA Document A305, "Contractor's Qualification Statement";
4. Additional documents issued by the Owner.

B. Obtaining Qualification Documents: Complete sets of the Qualification Documents are contained herein. Prospective Bidders shall use complete sets of Qualification Documents in preparing their bid documents. Owner assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Qualification Documents. Incomplete bid documents may be rejected by the Owner.

C. Interpretation or Correction of Qualification Documents: If the Bidder is in doubt as to the interpretation of any part of the Qualification Documents, or finds discrepancies in or omissions from any part of the Qualification Documents, it must submit a written Request for Interpretation thereof no later than five (5) working days prior to acceptance of bid documents. Address all communications to the Architect / Construction Manager as outlined in Specification Section 003000, Instruction to Bidders.

1.4 QUALIFICATION PROCEDURES

A. Form of Qualification Submittal shall include the following, properly executed and with all items filled out in ink or typed, and all additional data, attachments, and forms provided. Do not change or add words to the Qualification Statement or forms. All signatures must be original (and sealed if a corporation) and must be notarized and sealed by a Notary Public.:

1. Section 1.9 “Relevant Experience Verification Form” contained within this Requirements for Qualifications specification section;
2. Cordogan Clark & Associates Contractor Pre-Qualification Form; (See Exhibit’s Section)
3. AIA Document A305, "Contractor's Qualification Statement";

B. Modification to Requirements for Qualification:

1. Clarifications, alterations, or changes made by Architect, Construction Manager, or Owner to the Requirements for Qualification shall be in writing only. Verbal information is not valid or binding.
2. Modifications will be emailed to those Prospective Bidders having obtained Bid Documents from the issuing office.

C. Submission of Qualification Documents:

1. Each Submittal of Qualifications shall be included with the Bid proposal as outlined in Specification Section 003000, Instructions to Bidders.
2. It is the sole responsibility of the Prospective Bidder to ensure that its submittal is received by the submittal date and time. No submittal submitted after the time fixed for receiving submittals will be considered; late submittals will be returned to the Prospective Bidder unopened.
3. Owner reserves the right to waive any informality and to request additional information from Prospective Bidders, at Owner's discretion.

D. Attachments:

1. Prospective Bidders shall complete all required forms and attachments described in the Qualification Documents, entering "Not Applicable" where information does not apply. Absence of any of the forms included in the Prequalification Documents will be reason for possible disqualification.

E. Status of Prospective Bidders:

1. Proprietors submitting bids shall indicate their status as proprietors.
2. Prospective Bidders submitting qualifications for partnerships shall indicate their status as partners and shall submit a certified copy of the power of attorney authorizing the executor of the submittal to bind the partnership.
3. Prospective Bidders submitting qualifications for corporations shall indicate their status as corporations and shall submit a certified copy of the board of directors' authorization for the Prospective Bidder to bind the corporation and shall affix the corporate seal on the submittal.
4. Prospective Bidders shall provide the following:

    a. Names and addresses of proprietors, of all members of a partnership, or of the corporation's officers.
    b. Name of jurisdiction where the partnership is registered or where the corporation is incorporated. Corporations must be licensed to do business in Project state at the time of executing the Contract.

1.5 QUALIFICATION CRITERIA

A. Prospective Bidders must demonstrate the following to the satisfaction of Owner:

1. The ability to self-perform the primary scope of work under contract.

2. Proper license under the laws and regulations governing their respective trade(s).
3. Capacity to provide Performance Bond, Labor and Material Payment Bond, and Insurance in a form acceptable to Owner in amounts adequate to bond the Work based on the scope indicated in the Bid Documents.
4. Applicable experience of firm as described in the Contractor's Qualification Statement, including the following:

    a. Experience of Firm: The firm in its current organization shall have successfully completed a minimum of five projects of similar type, quality, and scope, including a minimum of two within the three years. The firm shall have a record of project completion, credit record, record of judgment claims, arbitration proceedings, and suits pending or outstanding acceptable to Owner.
    b. Experience of Firm Officers: The firm officers shall have personal record of project completion acceptable to Owner.
    c. Experience of Project and Field Management Staff to Be Committed by the Prospective Bidder to Carry Out the Work: The assigned project manager and field superintendent must have successfully completed minimum of three projects of similar type, quality, and scope.
    d. For purposes of this submittal, reference to "key individuals" as described in the Contractor's Qualification Statement shall be understood to mean the principal in charge, the project manager(s), and the project field superintendent(s) committed by the Prospective Bidder to carry out the Work of this Project. Prospective Bidder by submitting qualifications of key individuals agrees that Owner reserves the right to approve or reject subsequent reassignment of key individuals.
    e. For purposes of this submittal, "successful completion" shall be understood to mean completion of project within project schedule and budget. Provide additional information indicating reasons why any referenced project did not meet project schedule or project budget.

f. For purposes of this Qualification, "similar project" shall be understood to include the following project elements:

1) Reinforced masonry load-bearing construction.
2) Long-span, steel-framed roof structure.
3) Automated building systems (controls, fire detection and alarm, technology wiring infrastructure, intercommunications).
4) Renovation/addition work on occupied sites (if similar to the scope and size of the proposed project.)

5. Adequate financial resources, including ability to secure materials and labor necessary for completion of the Work and other work in hand, within the anticipated contract times, and reflecting the anticipated retainage from progress payments.
6. Work-in-hand capacity, such that the Prospective Bidder demonstrates adequate work under contract to continue its business operations at least at their current level, at the same time indicating the capability to carry out Owner's proposed work.
7. Adequate organization to complete work of the scope anticipated, including firm management, project management, field superintendence, and field engineering and quality control.
8. Acceptable past performance as indicated by firm's references, including ability to meet contract time and to monitor, manage, and communicate interim scheduling requirements, to carry out required quality-control activities, to properly prepare interim and final payment requests, and to successfully complete project closeout requirements.
9. Acceptable documentation of firm's employee screening practices as indicating by affidavit describing background check procedures for firm's employees and requirements for same incorporated in firm's subcontracts.
10. The character, integrity, reputations, judgment, experience and efficiency of the bidder and the quality of performance of previous contracts or services performed as evidenced by the feedback obtained by references contacted. References may include contacts provided by the Bidder or obtained by other means who can attest to the aforementioned evaluation criteria.

B. Consideration of qualifications may be withheld if the Qualification Statement shows any unexplained erasures, omissions, alterations of form, additions not called for, added restrictions or qualifying conditions, or other irregularities of any kind.

C. Owner may make such investigations as it deems necessary to determine the ability of the Prospective Bidder to perform the Work, and the Prospective Bidder shall furnish to Owner all such information for this purpose as Owner may request. Owner reserves the right to withhold qualification if the evidence submitted by or investigation of such Prospective Bidder fails to satisfy Owner that such Prospective Bidder is properly qualified to carry out the obligations of the proposed Project. The determination of which bidders are prequalified is not protestable, except as allowed by law.

D. Qualification Submittal and data contained therein is considered privileged and confidential and will not be disclosed to any outside party except as required by law.

1.6 BONDS AND INSURANCE

A. The Prospective Bidder shall provide as part of the Submittal of Qualifications evidence of its ability to furnish below:

1. Performance Bond, a Payment Bond, and a Labor and Material Bond, each in the amount of 100 percent of the Contract Sum, with a corporate surety authorized to transact business in Project's jurisdiction.
2. Satisfactory certificates of insurance in the amount and types required by statute, but not less than the following:

a. Professional design errors and omissions insurance endorsement for delegated design by Contractor's professional engineer.
b. Workers' Compensation insurance provisions: statutory limits.
c. Commercial General Liability insurance provisions: at limits established by Owner in Project Contract Documents.

1.7 ACCEPTANCE OF QUALIFICATIONS

A. Prospective bidders will be notified of Owner's determination, within the bid evaluation period.

B. Evaluations will be confidential. Notifications will be publicly available information.

C. Owner may deny qualification if it finds one or more of the following:

1. The Prospective Bidder does not have sufficient financial capacity to perform the Work.
2. The Prospective Bidder does not have the appropriate experience or reputation to perform the Work, including, but not limited to, having met the experience or reputation criteria set forth herein.
3. The Prospective Bidder or any officer, director, or owner thereof has had judgments entered against him within the past five years for the breach of contracts for governmental or nongovernmental construction work including, but not limited to, design-build or construction management contracts.
4. The Prospective Bidder has been in substantial noncompliance with the terms and conditions of prior construction with Owner, or in documented substantial noncompliance with the terms and conditions of prior construction with another public body without good cause.
5. The Prospective Bidder or any officer, director, owner, or chief financial official thereof has been convicted within the past 10 years of a crime related to governmental or nongovernmental construction or contracting.
6. The Prospective Bidder or any officer, director, or owner thereof is currently debarred pursuant to an established debarment procedure from bidding or contracting by any public body, agency of another state, or agency of the Federal Government.
7. The Prospective Bidder failed to provide to the public body in a timely manner any information required by the public body relevant to the six preceding subparagraphs.
8. The Prospective Bidder provides false, nonresponsive, misleading, or incomplete information for items required herein.

D. The acceptance of a Prospective Bidder's qualifications will be an award of contract should the Prospective Bidder provide the lowest qualified responsive and responsible Bid, signed by a

duly authorized representative of Owner; no other act by Owner or its agents shall constitute the acceptance of qualifications. The acceptance of a Prospective Bidder's qualifications by Owner does not constitute a contract or promise to award a contract to the Prospective Bidder.

1.8 PROSPECTIVE BIDDER'S CHECKLIST

A. In an effort to assist the Prospective Bidder in properly completing all documentation required, the following checklist is provided for the Prospective Bidder's convenience. The Prospective Bidder is solely responsible for verifying compliance with prequalification requirements.

1. Reviewed the Qualification Documents, including the Requirements for Qualification, prior to preparing this submittal.
2. Section 1.9 “Relevant Experience Verification Form” contained within this Requirements for Qualifications specification section.
3. Cordogan Clark & Associates Contractor Pre-Qualification Form. (See Exhibit’s Section)
4. Prepared AIA Document A305, "Contractor's Qualification Statement," as required by the document instructions and by the Requirements for Prequalification, including all attachments and data required as part of the Qualification Statement, properly notarized.
5. Attached: Copy of applicable Contractor's license(s).
6. Attached: Resumes of key individuals.
7. Attached: Other attachments as necessary to provide information required.
8. By submitting notarized statement, the Prospective Bidder certifies that the Bidder can provide executed Performance Bond and Labor and Material Bond meeting requirements given in the Bid Documents.
9. By submitting notarized statement, the Prospective Bidder certifies that the Bidder can provide Certificates of Insurance in the amounts indicated in Specification Section 005000, “Supplementary General Conditions”.

1.9 RELEVANT EXPERIENCE VERIFICATION FORM

A. Attach additional sheets as required to complete this form in its entirety. Additionally, Bidder is also required to furnish with their bid the completed Cordogan Clark & Associates Contractor Pre-Qualification Form and AIA Document A-305, "Contractor's Qualification Statement."

1. List of all similar projects (and contract value) contracted with the Bidder that have been completed within the last 5 years.

_____

_____

_____

2. List of all similar projects completed for academic (K-12) institutions over the last 5 years that were contracted with the Bidder.

_____

_____

_____

3. List of five academic (K-12) references where similar work was contracted with and installed by the Bidder. Include organization name, contact name, phone, email, and any pertinent project details if not included w/ the above project experience lists.

_____

_____

_____

4. What work (be specific – field installation labor, administrative, etc. and % of total contract) is self-performed and what is subcontracted under their contract as defined by the scope of work?

_____

_____

_____

5. List staffing (quantities, title, roles) assigned to complete this project in the timeline outlined in Section 003000.

_____

_____

_____

6. List of Key Personnel to be involved in this project (include title/responsibilities)

_____

_____

_____

7. List of Current Workload and Status (projected through the end of current year)

_____

_____

_____

Signature: _____

Printed Name & Position: _____

Date: _____Firm Name: _____

Official Address: _____

Phone _____ Email _____

END OF DOCUMENT 003500

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

SECTION 004000 – FORM OF PROPOSAL

A. GENERAL

FORM OF PROPOSAL FOR: EAST AURORA HIGH SCHOOL 2027 MECHANICAL IMPROVEMENTS

SUBMITTED BY: _____DATE: _____

TO: Ashraf Kawash, Director of Buildings & Grounds, EASD #131

The undersigned having carefully examined the Contract Documents consisting of the following: Specifications (Inclusive of all Sections and Exhibits); Drawings; and Addenda, if any. As prepared by Cordogan, Clark & Associates, which Contract Documents form a component part of this Proposal, and having examined the premises and conditions affecting the work, proposes to furnish all labor and materials required for the Contractor as follows:

B. BASE BID

In accordance with Drawings and Specifications for general contract including all divisions of work as indicated in Work Included in the Specifications for General Construction and as shown in the drawings. The bidding general contractors' principal business shall be in Heating, Ventilation, and Air Conditioning. Proposal award will be issued to a single or multiple Bidders for all or select buildings depending upon the lowest aggregate responsive and responsible Bid(s) from qualified Bidders.

EAST AURORA HIGH SCHOOL 2027 MECHANICAL IMPROVEMENTS

I have walked the building with my construction team, and we have a thorough understanding of the existing conditions for the building.

I understand that I need to provide a site project superintendent (an employee of the prime contractor) for the project. This person will be on site daily to supervise the site activity for the duration of the project and coordinate all project schedules, change orders, RFI's, change directives and trades. Field foreman do not qualify for this role.

I understand that the Mechanical equipment designated with the suffix "CO-OP" in the mechanical equipment schedules will be purchased separately. I have included in my base bid all other mechanical equipment required to provide a complete system of operation, other than those indicated to be purchased through the "CO-OP".

Signature : _____

Printed Name : _____

BASE BID EAST AURORA HIGH SCHOOL

BASE BID (SCHEDULE OF VALUES) $_____

+ CONTINGENCY ALLOWANCE $_____750,000.00_____

TOTAL BASE BID AMOUNT: $_____

AS WRITTEN :_____

The undersigned understands that this proposal is for the work fully described in the specifications and individual Bid Package scope of work thereafter for which the proposal is intended.

C. ADDENDA

I acknowledge receipt of the following Addenda:

No._____ Date _____ No._____ Date _____

No._____ Date _____ No._____ Date _____

D. SCHEDULE OF ALTERNATES

The selected alternates will be used to determine the lowest qualified Bid for this Bid Package. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment and all alternates shall be inclusive of Contractor overhead and profit regardless of whether additive or deductive. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within 90 days of the Notice of Award unless otherwise indicated in the Contract Documents.

Bidder is required to note if alternate is additive, deductive, or no change from base bid amount. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE." If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE." The Bidder shall be responsible for determining from the Contract Documents the effects of each alternate on the Contract Time and the Contract Sum. Acceptance or non-acceptance of any alternates by the Owner shall have no effect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time. Refer to specification 012300 ALTERNATES for additional information.

ALTERNATE #01 (CHIMNEY STACK DEMOLITION)

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #02 (AREA G ROOF TOP UNIT REPLACEMENTS)

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #03 (ROOF REPLACEMENTS @ SECTIONS 24 & 25)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $___10,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #04A (ROOF REPLACEMENT @ SECTION 7)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____2,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #04B (ROOF REPLACEMENT @ SECTION 12)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____10,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #05A (ROOF REPLACMENTS @ SECTIONS 8, 10, 11, 13 & 15)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____10,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #05B (ROOF REPLACEMENTS @ SECTIONS 16, 17 &20)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____8,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #05C (ROOF REPLACEMENTS @ SECTIONS 9, 14 & 19)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____6,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #06A (ROOF REPLACEMENTS @ SECTION 36, 37 & 40)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____8,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

ALTERNATE #06B (ROOF REPLACEMENT @ SECTION 39)

SUBTOTAL $_____

+ CONTINGENCY ALLOWANCE $_____6,000_____

TOTAL ALTERNATE BID $_____

(CIRCLE ONE) ADD / DEDUCT / NO CHANGE

AS WRITTEN: _____

E. SCHEDULE OF VALUES

The following Schedule of Values shall be furnished for verification of scope of work, establish unit prices, and determine base bid. All work as identified in drawings to be included in Bid. Items identified in drawings but not as a specific unit price, to be included in miscellaneous item line. All unit costs are to include equipment, material, and labor costs, including overhead and profit. See Specification Section 012100 for description and assignment of allowances. Bidder must quote on all items called for in the Bid Proposal relative to their scope of work and / or Bid Package. Bidder is also required to email the Schedule of Values and Unit Pricing in Microsoft Excel (.XLS) electronic format one to 24 hours after Bid Due Date but no earlier or later to constructionadminaurora@cordoganclark.com .Bidders may attach a printed copy of the Schedule of Values in lieu of handwriting each entry.

	BASE BID EAST AURORA HIGH SCHOOL MECHANICAL IMPROVEMENTS	COST
	General Requirements	$
	Demolition (equipment and building related)	$
	Architectural Improvements (all non-electrical or mechanical work)	
	Concrete	$
	Masonry	$
	Miscellaneous Metals	$
	Rough and Finish Carpentry	$
	Roofing Architectural Sheet Metal	$
	Doors, Frames, Windows, Glazing, & Hardware	$
	Metal Stud Framing and Drywall	$
	Ceilings	$
	Flooring	$
	Paint	$
	Miscellaneous Architectural items	$
	Mechanical System Material and Equipment	
	Equipment- By Mechanical Contractor	$
	Materials- By Mechanical Contractor	$
	Mechanical System Installation	$
	Plumbing Materials	$
	Plumbing Installation	$
	Electrical Materials	$
	Electrical Installation	$
	Electrical- Lighting Materials	$
	Electrical- Lighting Installation	$
	Fire Alarms	$
	Fire Protection	$
	Miscellaneous items not addressed above	$
	General Conditions	$
	Cleaning and Existing Equipment & Finish Protection	$
	Insurance & Bonding	$
	Overhead and Profit	$
	SUB-TOTAL BASE BID:	$

F. UNIT PRICES

All unit costs are to include equipment, material and labor costs, including bonding, overhead and profit. Bidder must quote on all items called for in their Bid Package. This Form is required to be attached to the Bid Form. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work and for adjustment of the quantity given in the Unit-Price Allowance for the actual measurement of individual items of the Work. If the unit price does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE." Refer to specification 012200 UNIT PRICES for additional information.

SCHEDULE OF UNIT PRICES

Unit Price #	Description	Unit/Quantity
Unit Price #01	Furnish and Install 2’ x 2’ Acoustical Ceiling as specified	$_____S.F.
Unit Price #02	Furnish and Install new VCT flooring as specified	$_____S.F.
Unit Price #03	Furnish and Install new LVT flooring as specified	$_____S.F.
Unit Price #04	Furnish & install new duct detector connected to existing fire alarm system.	$_____EA.
Unit Price #06	Furnish & install Paint Grip primer and paint on exposed ductwork.	$_____L.F.
Unit Price #07	Furnish & install 1” thick domestic water pipe insulation on existing ½” domestic water abated piping.	$_____L.F.
Unit Price #08	Price to furnish and install 1” thick domestic water pipe insulation (as specified) on existing 1” domestic water pipe at abated areas.	$_____L.F.
Unit Price #09	Furnish & install domestic water pipe insulation corners on existing abated piping.	$_____EA.
Unit Price #10	Furnish and install (1) insulated metal window panel in existing window system as specified; assume 36”x48” panel dimensions.	$_____EA
Unit Price #11	Furnish and install (1) insulated low-e tinted glazing panel in existing window system as specified; assume 36”x48” panel dimensions.	$_____EA
Unit Price #12	Price to furnish and install 20 Linear Feet of 1.25” insulated chilled water piping for a typical terminal unit.	$_____EA.
Unit Price #13	Price to furnish and install 20 Linear Feet of 3/4” insulated hot water piping for a typical terminal unit.	$_____EA.

Unit Price #14	Price to furnish and install 20 Linear Feet of 3/4” insulated condensate piping for a typical terminal unit	$_____EA
Unit Price #15	Price to furnish and install (1) exhaust fan curb. Price shall include alterations and repair to the roof.	$_____E.A
Unit Price #16	Price to furnish and install new balancing damper in existing ductwork serving single existing grille.	$_____E.A
Unit Price #17	Price to remove and replace existing damaged brick in kind, and tooth into existing construction	$_____S.F.
Unit Price #18	Price to remove and replace 10 Square Feet (S.F.) of existing monolithic brick.	$_____E.A
Unit Price #19	Provide and install Watts LFUSG-B ASSE 1070 thermostatic mixing valve at existing sink or lavatory	$_____E.A
Unit Price #20	Provide and install clear 6 mil (min) polyethylene sheeting with taped seems for wall, ceiling, or furniture protection.	$_____S.F
Unit Price #21	Damaged insulation replacement. New polyisocyanurate insulation to be tapered to match existing.	$_____ S.F.
Unit Price #22	Replace roof drain assembly.	$_____E.A.
Unit Price #23	Fascia replacement as specified	$_____ L.F.
Unit Price #24	Treated Wood Blocking Replacement	$_____ L.F.

G. BID SECURITY

Accompanying the proposal is a Bid Bond or (Certified Check) as surety in the amount of not less than 10% of the Base Bid payable to the Owner, which it is agreed will be forfeited if the undersigned fails to execute the Contract in conformity with Specifications and Furnish Performance and Labor and Material Payment Bonds as specified within ten (10) days after notification of the award of the Contract to the undersigned

H. PERFORMANCE / PAYMENT BOND

The undersigned agrees to provide an acceptable Performance and Labor and Material Payment Bonds, in accordance with AIA Document A312, in the amount of 100% of the Base Bid of which the cost of the Bonds are included in the Bid.

I. ATTACHMENT

The undersigned acknowledges that he has read and understands the CERTIFICATE OF ELIGIBILITY TO BID attached to this Bid Form and signed and attested thereto. The undersigned further acknowledges that said CERTIFICATE OF ELIGIBILITY is a part of the Contract Documents and will be attached to the Agreement.

J. REJECTION AND WITHDRAWAL OF BID

The Owner reserves the right to accept or reject any or all of the above proposals.

K. TIME OF COMPLETION

The undersigned agrees, if awarded the Contract, to begin work immediately upon notification by the Architect. The undersigned agrees, if awarded the Contract, to complete the work within the time frame specified in Specification Section 003000.

L. SIGNATURES FORM

IF AN INDIVIDUAL:

Longhand Signature of Bidder: _____

Doing Business as: _____

Business Address: _____

City: _____State: _____Zip: _____

IF A CO-PARTNERSHIP:

Name of Firm: _____

By: _____

Business Address: _____

City: _____State: _____Zip: _____

Names and Addresses of All Members of the Firm:

_____

_____

_____

IF A CORPORATION:

Corporate Name: _____

A Corporation in State of: _____

By (President): _____

Name of Officers:
President: _____

Secretary: _____

Treasurer: _____

Corporate Seal:

ATTEST: _____

M. CERTIFICATE OF ELIGIBILITY TO BID

The Bidder/Contractor certifies that the Contractor is not barred from Bidding on the Contract as a result of a conviction for either Bid-Rigging or Bid Rotating under Article 33E of the Criminal Code of 1961. The Bidder/Contractor acknowledges that this certificate is a part of the Contract Documents and will be attached to the Owner/SP/Contractor Agreement.

Date: _____ Firm Name: _____

Official Address: _____

_____ By: _____

_____ Position: _____

Where Bidder is a Corporation, add:

Attest: _____
(Secretary) (Seal

Subscribed and Sworn to Before Me this _____day of _____, 20__

My Commission Expires: _____
Notary Public

_____, 20__ _____
Address

DRUG FREE WORKPLACE

The Bidder or Contractor, having 25 employees or more, does hereby certify pursuant to Section 3 of the Illinois Drug-Free Workplace Act (III. Rev. Stat. Ch. 127 132.313) that [he, she, it] shall provide a drug-free workplace for all employees engaged in the performance of work under the Contract by complying with the requirements of the Illinois Drug-Free Workplace Act, further certified that [he, she, it] is not ineligible for award of this Contract by reason of debarment for a violation of the Illinois Drug-Free Workplace Act.

Firm Name: _____

By: _____
(Authorized Agent of Contractor)

Title: _____

Subscribed and sworn to before me _____

This day of _____

CERTIFICATE OF COMPLIANCE WITH ILLINOIS HUMAN RIGHTS ACT

_____(Contractor), does hereby certify pursuant to P.A. 87-1257, the Illinois Human Rights Act, that (he, she, it) has adopted a written sexual harassment policy that includes at the minimum the following information: (I) the illegality of sexual harassment; (II) the definition of sexual harassment under Illinois law, (III) a description of sexual harassment, utilizing examples; (IV) internal complaint process including penalty; (V) the legal recourse, investigative and complaint process available through the Illinois Department of Human Rights and the Illinois Human Rights Commission; (VI) directions on how to contact the Department and Commission; and (VII) protection against retaliation as provided by Section 6-101 of the Illinois Human Rights Act.

By: _____

Its: _____

Date: _____

_____
Notary Public

CERTIFICATION REGARDING CRIMINAL BACKGROUND INVESTIGATIONS

Contractor hereby represents, warrants, and certifies that no officer or director thereof has any knowledge that any employee thereof has been convicted of committing or attempting to commit "Criminal Code of 1961," 720 ILCS, Sections 5/11-6 (Indecent Solicitation of a Child), 5/11-9 (Public Indecency), 5/11-14 (Prostitution), 5/11-15 (Soliciting for a Prostitute), 5/11-15.1 (Soliciting for a Juvenile Prostitute), 5/11-9 (Pimping), 5/11-19.1 (Juvenile Pimping), 5/11-19.2 (Exploitation of a Child), 5/11-20 (Obscenity), 5/11-20.1 (Sexual Assault), 5/12-14 (Aggravated Criminal Sexual Abuse), and/or those offenses defined in the "Cannabis Control Act," 720 ILCS 570/100 et. seq. And/or any offense committed or attempted in any state or against the laws of the United States, which if committed or attempted in this State, would have been punishable as on or more of the foregoing offenses.

Contractor further agrees that it shall not employ any person who have or may have direct, daily contact with the pupils of any school in the district, and for whom a criminal background investigation has not been conducted pursuant hereto, and further represents and agrees that all applicants for any such employment shall furnish with their applications the attached written "Authorization for Criminal Background Information" form authorizing the Board of Education to request a criminal background investigation of said applicant pursuant to Section 5/10-21.9 of the School Code of Illinois and to receive criminal history record information pursuant thereto to determine if the applicant has been convicted of committing or attempting to commit any of the criminal or drug offenses enumerated above. Contractor further agrees to submit with said authorization payment for any costs and expenses associated with the criminal background investigation.

Contractor further represents, warrants, and certifies that no applicant for employment with respect to whom the criminal investigation reveals any conviction for committing and/or attempting to commit any of the above enumerated offenses, shall be employed thereby in any position that involves or may involve contact with the students of the school district.

This certification is executed on the date hereinafter indicated by the designated contractor by its duly authorized officer.

By: _____

Its: _____

Date: _____

END OF SECTION 004000

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Work restrictions.
5. Period of performance
6. Specification and drawing conventions.
7. Rebates

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: East Aurora High School 2027 Mechanical Improvements, East Aurora School District #131.

1. Project Location: 500 Tomcat Lane, Aurora, IL 60505 refer to attached building information sheet for use, age and approximate square feet

B. Client/ Owner:
East Aurora School District #131,
310 Seminary Avenue., Aurora, IL 60505.

C. Architect/Engineer/Construction Manager:
Cordogan Clark & Associates, Inc.,
515 Redwood Dr, Aurora, IL 60506.

D. Project Web Site: A project Web site administered by Architect will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using the Project Web site.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. Type of Contract:

1. Project will be constructed under a Bid Build Contract.

B. Background

1. The intent of this installation is to replace the existing mechanical systems throughout Cowherd Middle School to provide conditioned spaces throughout the buildings and reduce energy consumption by replacing all mechanical systems.

C. The Work of Project is defined by the Contract Documents and consists of the following:

1. Mechanical system replacement at Cowherd Middle School work to include related architectural improvements, replacement, installation of new mechanical systems, controls, electrical, plumbing, service, and a parts and labor warranty for a period of 2 years. Contractors shall provide a total base bid for each project based on the contract documentation and site visits. The awarded Contractor/s shall be integrally involved with the ordering of the equipment.

2. All bid proposals shall include a Critical Path Method schedule outlining Major and Minor schedule milestones, as well as a plan indicating where work will occur with start and finish dates. The proposed schedules shall include the dates outlined in the milestone exhibits. The Preliminary Construction Schedule is required as part of the Bid Submission and will be used to evaluate the recommended awarded bidder. It is crucial that the schedule uses the critical path method that outlines Major and Minor schedule milestones. A plan indicating where work will occur with start and finish dates to complete the project as indicated in Preliminary Schedules is required as well.

3. All products provided for these projects must be uniformed in manufacturers, makes and models, varying products for the schools will not be accepted unless approved by the architect/engineer.

4. Perform and complete all work as required by and in accordance with the conditions of contract, drawings, specifications, and specifics below. The Scope of Work includes: furnishing all supervision, insurance, fees, permits, bonds, labor, material, equipment, tools, utility services coordination, testing, called inspections, facilities and services necessary, inherent or incidental to perform the installation of the work as summarized below and in accordance with the drawings, specifications, schedules and other Contract Documents.

5. Limited access to the buildings may be available at the schools, during the 2023-2024 school year for construction, during evenings, weekends and school breaks. Bidding

contractors shall provide a schedule for district approval to do preliminary work prior to the summer break that would not impact teaching. This schedule shall be organized by areas of the building with description of work to be performed and how the work would impact spaces, the overall schedule and the price of construction. Any work performed in student or staff areas shall be put back in a clean and usable condition prior to the following morning when students/ staff return to the spaces. This schedule is intended for owner evaluation purposes and submission does not guarantee early access to the space. Provide a voluntary deduct if early access warrants a cost savings.

6. The new emergency rules from the IL State Board of Education mandates that school districts are required to verify that contractor employees who meet the definition of "School Personnel" are either fully vaccinated or undergoing weekly testing. All contractors working on these projects will be obliged to follow these requirements and each company will be required to provide the required Attestation of Compliance with Executive Order and supporting documents prior to entering the buildings.

7. Mechanical Equipment Procurement Process
   a. Mechanical equipment designated with the suffix "CO-OP" in the mechanical equipment schedules will be purchased by the Owner and installed by the mechanical contractor. The mechanical contractor is not to include the cost to purchase this mechanical equipment in their base bid. The mechanical contractor will coordinate with the Owners representative regarding equipment configuration items, such as coil hand, etc. This is required to occur as soon as Notice to Proceed is issued on October 17, 2023 and must be completed and submitted by October 25, 2023. Access to the schools will be limited to weekends, school breaks and outside of school hours on weekdays. The contractor shall figure into their budget and schedule accordingly. If the contractor does not complete the equipment selection submittals on time a Liquidated damage fee of $5,000 per day per school will be assessed and delayed equipment ordering will not permit the completion date of the construction completion dates to be adjusted. Mechanical equipment will be shipped from the supplier to the contractor's storage facility.
   b. The Purchase of Mechanical Equipment, Controls and Warranties for the 2023 Mechanical System Replacement Project at Cowherd Middle Schools are through the Omnia Partners Cooperative Purchasing Agreement with Trane Technologies in collaboration with Trane Chicago.
   c. Mechanical equipment designated with the suffix "-MC" in the mechanical equipment schedules will be purchased by the mechanical contractor. If equipment is not specified to be purchased through the "CO-OP", then it is the Mechanical Contractors responsibility to provide the equipment as part of their bid whether listed or not. Submittals shall be submitted per the milestone schedule on November 7, 2023, and confirmation of all equipment purchases shall be provided to the owner by November 21, 2023.
   d. Contractor to provide storage for all mechanical equipment until it is needed at the site, including indoor storage for all equipment not intended to be outside. Contractor is responsible to transport equipment as needed to each respective building.
   e. Contractor's warranty shall include all mechanical equipment installed as part of their contract project and shall be a minimum of two years on parts and labor, excluding mechanical equipment supplied by others. Equipment supplied by others shall include a minimum two years on parts and labor, that is that party's responsibility to manage.

f. The contractor shall bring in an alarm contractor to verify the existing state of the current fire alarm system prior to the start of construction. Any concerns about the existing system current state of operation shall be brought to the Architect and districts attention to be addressed during construction. Any damaged done to the system during construction will be the contractor's responsibility to repair at no additional cost to the district.

g. The Mechanical contractor shall provide an alternate bid number to provide a mechanical service agreement of 2 years after the completion of the project. The service agreement shall provide a quarterly filter replacement for all equipment with filters, seasonal spring and fall cleaning to remove cottonwood and other debris from condenser coils and equipment located outdoors and changing of boiler combustion air filters. Equipment tune ups are required every 6 months, including but not limited to, verification of gas heating equipment operation in the fall and verification of DX cooling performance in the spring. Other manufacturer-required equipment maintenance is to be performed at manufacturer-specified intervals.

8. Temperature Controls

   a. Temperature controls for the project will be by Trane Chicago. Trane will be under contract to the Owner. Trane will provide control valves for installation by the mechanical contractor. Unless otherwise noted on the plans and schedules, the mechanical contractor will provide control dampers and Trane will provide damper actuators. The mechanical contractor will be responsible for coordinating and scheduling of all associated Trane work. Contractor's critical path scheduling shall include time for controls/balancing and commissioning of systems and allocate the necessary time for equipment to be started and functioning prior to the scheduled date for ROE walkthrough as shown on the milestone exhibits.

9. During the construction phase of the project Cordogan Clark and Associates shall be involved in all weekly construction meetings with the prime and sub-contractors.

10. The awarded contractor(s) will be required to provide a minimum of one full-time on-site project superintendent (an employee of the prime contractor) at each building for the purposes of supervision of the site activity for the duration of the project and coordinate all project schedules, change orders, RFI's, change directives, trades, etc. The building superintendent shall not be a field worker and will be responsible for leading weekly OAC meetings for their building.

11. The Contractor shall provide updated schedules, at weekly intervals, to reflect actual construction progress and activities. A weekly schedule (5-week look ahead) are to be provide for weekly OAC meetings. Issue schedules (1) day before each regularly scheduled progress meeting. See specification 013200 Construction Progress. If any major schedule changes occur, the schedule shall be updated and distributed within (2) business days.

12. All coordination questions shall follow proper RFI standard procedures as indicated in Section 013100- Project Management and Coordination. If work requires double shifts, all RFI's generated by second shift shall be submitted in writing to Cordogan Clark and Associates and will be respond to within 72 hours or as specified of next business day. All change directives shall come from Cordogan Clark and Associates and shall follow Section 012600 Contract Modifications. Any responses or change directives from consultants shall not be viewed as official directives and must come through Cordogan Clark and Associates to be official.

13. Complete commissioning of all systems as required by the specifications and Owner Commissioning agent. See milestone schedule for required commissioning dates. The Contractor is required to coordinate and schedule with Trane Chicago and commissioning agent to ensure that the schedule is followed.

14. Industry standards referenced in the specifications represent the minimum requirement for performing the work. Contractor shall provide greater quantity or quality of work where the requirements of governing authorities and the contract documents exceed industry standards.

15. Prior to commencement of the mechanical work, all existing led light fixtures and controls that are to be impacted by the work shall be carefully removed by electrical contractor (e.c.) to contractor's secure storage prior to ceiling demolition. Coordinate with the mechanical contractor lights being impacted. Provide temporary lighting as needed. E.C. shall re-install salvaged led light fixtures and controls per new ceiling and floor plans. Restore lighting and controls to original working order and include any control programming needed. Coordinate with the fixture manufacturer(s) for continuity of the existing 20-year parts and labor warranty at the conclusion of the work; do not make unauthorized modifications or substitutions without the manufacturer's agreement.

16. The Contractor shall coordinate all work required before and after abatement. Abatement work will be by others. The contractor shall coordinate the removal and reinstallation of required items for the abatement projects. Work that is preformed over spring break will required the removal and reinstallation of electrical items including but not limited to light fixtures, smoke detectors, occupancy sensors, security cameras, WAP devices, etc. Coordination of lighting removal with the fixture owner/ warranty holding contractor is the Contractor's responsibility. This work must be done prior to the start of the abatement and must be reinstalled prior to students and staff returning to the building.

    a. Spring Break Abatement work if any
        1) March 29-April 2, 2027
    b. Boiler Abatement and Demolition
        1) April 15-10, 2027
    c. Remaining Abatement
        1) June 7-10, 2027

17. Prior to the end of the 2026-2027 school year the contractor shall coordinate required furniture and equipment move out and storage locations with the owner. This will require the contractor to inform the owner of areas that need to be cleared out, areas items can remain and to coordinate the protection of items to remain in the buildings.

18. Notification to the district should be coordinated through the Construction Managers. If direct coordination is required during the project for items similar to, but not limited to move out, move in, etc.. These items should go through the Assistant Superintendent for Operations or the Director of Buildings and Grounds, not general staff.

19. The buildings in this contract were built prior to 1979 and could contain lead paint. The contractor shall acknowledge this by submitting a bid for these projects and must follow all code required regulations. See specification 028319 - Lead-Based Paint Abatement.

1.5 ACCESS TO SITE

A. General: Contractor shall have limited access to the Project sites for construction operations during the portions of the construction period and full access during East Aurora School District's 2024 Summer Break. Contractor's use of Project site is limited to hours outside of student occupied dates and times of day.

1.6 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
2. All areas impacted by this project must be returned to the pre-construction condition prior to occupancy by students and staff the following day. Shift work is anticipated and required to complete this project within the identified schedule.

B. On-Site Work Hours:
1. Summer Hours (May 31 – August 4, 2027): Limit work to normal business working hours of 6 a.m. to 10 p.m., Monday through Saturday, except as otherwise arranged with the Owner.
2. Student/ Staff Occupied Hours: Limit work to after school hours of 3:30 pm to 11:00 p.m., Monday through Friday, except as otherwise arranged with the Owner.
3. Weekend Hours: Coordinate with the Owner.
4. Early Morning Hours: Coordinate with the Owner.
5. Hours for Utility Shutdowns: Coordinate with the Owner.
6. School Holidays: Coordinate with the Owner.

C. Controlled Substances: Use of tobacco products, vaping devices and other controlled substances on Project site is not permitted.

1.7 PERIOD OF PERFORMANCE

A. The period of performance is multi-year, extending for two (2) years after the date of final completion and acceptance of the mechanical system.

B. Delivery Schedule
1. Installation of all mechanical solutions within agreed schedule from date of award.
2. Maintenance of all mechanical solutions installed from date of installation through the term of the contract.
3. Upgrade of all mechanical solutions when benefits exceed costs.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations as scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 REBATES

A. The equipment specified for the above listed projects is eligible for Rebate incentives from both Nicor and ComEd. The awarded contractor shall coordinate with the district and the utility companies to provide the required documentation for the district to receive all eligible incentives. The contractor will take the lead on all applications for rebates and be the point of contact for both utility groups (two separate applications).

B. The Contractor shall:
1. Document the existing equipment prior to demolition
    a. Photo documentation of all existing equipment/conditions
    b. Equipment tag information
2. Provide required invoicing/ receipts for all new eligible equipment (provide installed cost by unit)
3. Provide all required equipment data.
4. Coordinate (with the district and the utility company) and complete all required applications and provide all documents required by Nicor and ComEd for approval on the eligible incentives.

C. Schedule:
1. Begin application inquiry with ComEd & Nicor no later than 10 business days from Notice to Proceed.
2. Submit pre-approval applications within timeframe specified by utility companies.
3. Submit final application within timeframe specified by utility company.

1.10 CLOSEOUT

A. The Service Provider shall:

1. Transfer maintenance stock to Institution at the end of the contract period.
2. Provide an end-of-contract audit of the entire mechanical system.
3. Transition operation of control and monitoring system to Institution.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements governing the following:

1. Contingency allowances

2. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, coordinate with Owner the date when final selection and purchase of each product or system described by an allowance will be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems required to install Owner provided items from the designated supplier.

1.3 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

D. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.4 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.5 CONTINGENCY ALLOWANCES

A. Use the allowance only as directed by Architect for Owner’s purposes IN WRITING.

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance 1 –
Contingency Allowance:
1. Allowance includes material cost, installation cost, delivery, insurance, overhead and profit.

B. See Section 004000 Form of Proposal for allowances assigned to each bid package.

END OF SECTION 012100

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SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Division 01 Section "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Cowherd Middle School - See Section 004000 Form of Proposal for unit prices assigned to the bid package.

END OF SECTION 012200

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SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Alternate pricing shall remain open for a period of not less than 90 Days.

E. Schedule: Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Cowherd Middle School - See Section 004000 Form of Proposal for alternates assigned to the bid package.

END OF SECTION 012300

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Division 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment. Related Requirements:

1. Division 01 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Division 01 Section "Unit Prices" for administrative requirements governing the use of unit prices.
3. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
4. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets.
2. Submit the Schedule of Values to Architect at earliest possible date but no later than ten days before the date scheduled for submittal of initial Applications for Payment.

3. Sub schedules: Where the Work is separated into phases requiring separately phased payments, provide sub schedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of ten (10%) percent of the Contract Sum.

    a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling ten (10%) percent of the Contract Sum and subcontract amount.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. Contractor to comply with AIA Document A201-2007 General Conditions of the Contract for Construction, see Article 9 Payments and Completion, Section 9.3 Applications for Payment and Section 9.3.2.

7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Reviewed Applications for Payment shall be submitted to Architect no later than 5 business days before the end of the current period. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

4.

F. Transmittal: Submit three (3) signed and notarized original copies of each Application for Payment and waivers of lien and similar attachments to Architect by a method ensuring receipt within 24 hours. One copy shall include Certified Payroll report(s) for the pay period.

    1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

    1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
    2. When an application shows completion of an item, submit conditional final or full waivers.
    3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
    4. Initial application for payment shall be accompanied by the Contractor’s partial waiver of lien only for the full amount of the payment.
    5. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

H. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

    1. List of subcontractors.
    2. Schedule of Values.
    3. Contractor's Construction Schedule (preliminary if not final).
    4. Schedule of unit prices.
    5. Submittals Schedule (preliminary if not final).
    6. List of Contractor's staff assignments.
    7. List of Contractor's principal consultants.
    8. Copies of building permits.

9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.

I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project Web site.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:
1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.5 The General Contractors site superintendent shall be required to have had experience in the construction and coordination of at least (3) similar facilities.

1.6 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.7 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements and additionally where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity. Minimum requirements for Coordination Drawings for the following, (but not limited to) Subcontracts:

1) Steel
2) Mechanical (HVAC)
3) Mechanical (Plumbing)
4) Electrical (Including Data)
5) Fire Protection

Note: Coordination Drawings are not to be considered shop drawings for review. Coordination drawings and/or meetings are to take place prior to shop drawing submittals. Coordination meeting is to take place early in the project schedule. Subcontractors are required to prepare questions in the form of RFIs to be reviewed and discussed. Do not submit RFIs to Architect prior to coordination meeting.

2. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.

b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Post coordination drawing files using Portable Data File (PDF) format.

3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
b. Digital Data Software Program: Drawings are available in AutoCad Architecture 2008.
c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual. See Section 013300 Submittal Procedures.

1.8 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Form: Use the RFI Form included within the Exhibits. Submit RFI's electronically in PDF format via Submittal Exchange (www.submittalexchange.com).

1. Identify each page of attachments with the RFI number and sequential page number.

D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow working days for Architect's response for each RFI as indicated below. RFIs received after 1:00 p.m. will be considered as received the following working day.

1)	Architecture:	(3) working days
2)	Steel:	(5) working days
3)	Mechanical (HVAC):	(5) working days
4)	Mechanical (Plumbing):	(3) working days
5)	Electrical:	(3) working days
6)	Fire Protection:	(3) working days

The Contractor and/or Construction Manager is required to allow the above listed time outline for the submittal schedule approval prior to construction commencing.

2. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

3. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
4. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of Project Web site. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within five (5) working days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.9 PROJECT WEB SITE

A. Use Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:

1. Project directory.
2. Project correspondence.
3. Meeting minutes.
4. Contract modifications forms and logs.
5. RFI forms and logs.
6. Task and issue management.
7. Photo documentation.
8. Schedule and calendar management.
9. Submittals forms and logs.
10. Payment application forms.
11. Drawing and specification document hosting, viewing, and updating.
12. Online document collaboration.
13. Reminder and tracking functions.
14. Archiving functions.

B. Provide up to seven Project Web site user licenses for use of the Owner, Architect, and Architect's consultants. Provide four (4) hours of software training at Architect's office for Project Web site users.

C. On completion of Project, provide one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.

D. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of Agreement included in this Project Manual. See Submittal Procedures, Section 013300.

1.10 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three 3 working days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 working days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Lines of communications.
    f. Procedures for processing field decisions and Change Orders.
    g. Procedures for RFIs.
    h. Procedures for testing and inspecting.
    i. Procedures for processing Applications for Payment.
    j. Distribution of the Contract Documents.
    k. Submittal procedures.
    l. Preparation of record documents.
    m. Use of the premises.
    n. Work restrictions.

o. Working hours.
p. Owner's occupancy requirements.
q. Responsibility for temporary facilities and controls.
r. Procedures for moisture and mold control.
s. Procedures for disruptions and shutdowns.
t. Construction waste management and recycling.
u. Parking availability.
v. Office, work, and storage areas.
w. Equipment deliveries and priorities.
x. First aid.
y. Security.
z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 60 calendar days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of record documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Submittal of written warranties.
    d. Requirements for preparing operations and maintenance data.
    e. Requirements for delivery of material samples, attic stock, and spare parts.
    f. Requirements for demonstration and training.
    g. Preparation of Contractor's punch list.
    h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    i. Submittal procedures.
    j. Installation of Owner's furniture, fixtures, and equipment.
    k. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule,

in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction

schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's Construction Schedule.
2. Submittals Schedule.
3. Daily construction reports.
4. Field condition reports.

B. See Division 01 Section "Payment Procedures" for submitting the Schedule of Values.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

B. Submittals Schedule: Submit PDF electronic files of schedule for approval. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's final release or approval.

C. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review submittal requirements and procedures.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for Project closeout and Owner startup procedures**,** including commissioning activities, if required.
9. Review and finalize list of construction activities to be included in schedule.
10. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.
3. Enter the approved submittals schedule dates into Submittal Exchange (www.submittalexchange.com).

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in ten (10) percent increments within time bar.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM /GANTT CHART SCHEDULE)

A. CPM / Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, with Critical points and mile stone requirements, Contractor's Construction Schedule within twenty (20) days of date established for commencement of the Work. Base schedule on the Preliminary Construction Schedule and whatever updating, and feedback was received since the start of Project.

B. General: Prepare network diagrams using AON (activity-on-node) format.

C. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in ten (10) percent increments within time bar.
2. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

D. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.

E. Startup Network Diagram: Submit diagram within 20 days of date established for commencement of the Work . Outline significant construction activities for the entire construction duration. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

F. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

G. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and commissioning.
    j. Punch list and final completion.
    k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates. Treat each story or separate area as a separate numbered activity for each principal element of the Work.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.

    a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
    b. Total cost assigned to activities shall equal the total Contract Sum.

H. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

I. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.

4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

J. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

K. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests, coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

4. If an act of God occurs affecting the arrival of equipment and or materials, the General contractor shall provide an updated schedule immediately showing the sequences affected. The project schedule should not extend further then the time of the delay. All items not affected by this act are expected to move forward per the original schedule and potentially be moved ahead of schedule when possible.

B. Distribution: Distribute electronically in PDF format copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final completion construction photographs.

B. Related Requirements:

1. Section 012200 "Unit Prices" for procedures for unit prices for extra photographs.
2. Section 013300 "Submittal Procedures" for submitting photographic documentation.
3. Section 017700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
4. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
5. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
6. Section 024119 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.
7. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 UNIT PRICES

A. Basis for Bids: Base number of construction photographs on average of 30> photographs per week, per school over the duration of Project.

1.4 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Digital Camera: Minimum sensor resolution of 8 megapixels.
2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
3. Identification: Provide the following information with each image description in file metadata tag:

    a. Name of Project.
    b. Name and contact information for photographer.
    c. Name of Architect and Construction Manager.
    d. Name of Contractor.
    e. Date photograph was taken.
    f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    g. Unique sequential identifier keyed to accompanying key plan.

1.5 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

B. Web-Based Photographic Documentation Service Provider: A firm specializing in providing photographic equipment, Web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.6 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in file name for each image.
2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect and Construction Manager.

D. Periodic Construction Photographs: Take 30 photographs weekly, at each school, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Construction Manager-Directed Construction Photographs: From time to time Construction Manager will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take 30> color photographs, per school, after date of Substantial Completion for submission as project record documents. Construction Manager will inform photographer of desired vantage points.

1. Do not include date stamp.

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.

C. See Division 01 Section "Quality Requirements" for submitting test and inspection reports.

D. See Division 01 Section "Closeout Procedures" for submitting warranties.

E. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

F. See Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

G. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Submit all submittals in PDF format electronically via Submittal Exchange (www.submittalexchange.com).

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule and based on Section 013300a Shop Drawing Schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name and address of Contractor.
    e. Name and address of subcontractor.
    f. Name and address of supplier.
    g. Name of manufacturer.
    h. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

    i. Number and title of appropriate Specification Section.
    j. Drawing number and detail references, as appropriate.

k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.

1. Transmittal Form: No transmittal form required for submittals submitted only through Submittal Exchange. For submittals that are required via hardcopy, Use AIA Document G810.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked "Approved" or "Approved As Noted" notation from Architect's action stamp.

J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

K. Use for Construction: Use only final submittals with mark indicating "Reviewed" or "Reviewed As Noted" notation from Architect's action stamp taken by Architect.

1.4 CONTRACTOR'S USE OF ARCHITECT'S DIGITAL DATA FILES

A. Architect's Digital Data Files: Electronic copies of digital data files of THE BASE PLANS ONLY of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Contractor shall execute a data licensing agreement in the form of the Architect's digital exchange agreement.
c. BASE PLANS

d. A 3D Building Information Model (Revit file) is available if requested.

B. General: At Contractor's written request and upon receipt of a completed and signed Electronic Release of Liability Form, copies of Architect's digital data files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. Provided Cordogan, Clark & Associates, Inc. CCA exercises reasonable care in the electronic or disk transmission of data, information or documents to the above indicated receivee, the receivee shall be responsible for and solely bear all damages, losses or expenses it or Cordogan, Clark & Associates, its employees, officers and consultants incur as a result of:

   a. Errors or defects introduced by such transmission
   b. The Receivees' and its independent contractors' or agents' automated conversion or reformatting of the data, information or documents transmitted
   c. Defects or errors in the Receivees' and its independent contractors' or agents' software or hardware utilized to receive, transmit, utilize, format or reproduce data, information or documents

2. Provided Cordogan, Clark & Associates and its consultants have exercised reasonable care in the selection and operation of hardware and software for its computer aided design services, Cordogan, Clark & Associates shall not be responsible or liable for errors, defects, inexactitudes or anomalies in data, information of documents (including drawings and specifications) caused by:

   a. Cordogan, Clark & Associates or its consultants' computer software or hardware defects or errors
   b. Cordogan, Clark & Associates consultants' electronic or disk transmittal of data, information or documents
   c. Cordogan, Clark & Associates reformatting or automated conversion of data, information or documents electronically or disk transmitted from Cordogan, Clark & Associates' consultants to Cordogan, Clark & Associates.

3. Receivee waives all claims against Cordogan, Clark & Associates, its employees, officers and consultants for damages, losses or expenses it incurs arising from such defects or errors.

4. If as otherwise permitted by this Agreement, the Receivee shall electronically or by disk transmit data, information or documents (including drawings and specifications) to persons other than Cordogan, Clark & Associates, the Receivee shall be responsible for and solely bear all damages, losses or expenses arising from:

   a. errors or defects introduced by such transmission
   b. errors or defects introduced by such persons retransmission, automated conversion, reformatting, or reproduction of such data, information or documents

5. Receivee shall indemnify, defend and hold Cordogan, Clark & Associates and its consultants, together with their respective employees and officers, harmless from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorneys' fees and litigation expenses) resulting or arising from errors of

defects in data, information or documents, including drawings and specifications, caused or introduced by the Receivee (or its independent contractors and agents):

a. Provision or transmission of data, information or documents to Cordogan, Clark & Associates
b. Re-transmission, automated conversion, reformatting or reproduction of Cordogan, Clark & Associates created data, information or documents
c. Use of defective, erroneous or incompatible software or hardware.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. Submit all submittals electronically via Submittal Exchange (www.submittalexchange.com).

B. General: Prepare and submit Action Submittals required by individual Specification Sections.

C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Manufacturer's catalog cuts.
e. Wiring diagrams showing factory-installed wiring.
f. Printed performance curves.
g. Operational range diagrams.
h. Compliance with specified referenced standards.
i. Testing by recognized testing agency.

4. Number of Copies: Submit electronically in PDF format via Submittal Exchange. Mark up and retain one returned copy as a Project Record Document.

D. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's Digital Drawings is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.

e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Notation of coordination requirements.
j. Notation of dimensions established by field measurement.
k. Relationship to adjoining construction clearly indicated.
l. Seal and signature of professional engineer if specified.
m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 24 by 36 inches (750 by 1000 mm).
3. Number of Copies: Submit electronically in PDF format.

E. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of appropriate Specification Section.

3. Provide a scan and photos of the sample submitted and submit via Submittal Exchange for tracking and record purposes.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one (1) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

b. Submit a scan and/or photos of the samples in PDF format via Submittal Exchange at the time of initial submittal to the Architect for tracking and record keeping purposes. Architect may stamp and return scan via Submittal Exchange in lieu or addition to returning actual sample(s).

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the

following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three (3) sets of Samples. Architect will retain two (2) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.

b. Submit a scan and/or photos of the samples in PDF format via Submittal Exchange at the time of initial submittal to the Architect for tracking and record keeping purposes. Architect may stamp and return scan via Submittal Exchange in lieu or addition to returning actual sample(s).

F. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.

1. Number of Copies: Submit electronically in PDF format via Submittal Exchange.

G. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

I. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A.

1. Number of Copies: Submit electronically in PDF format via Submittal Exchange.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit electronically in PDF format via Submittal Exchange.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

M. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during

installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

Q. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.

S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

U. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.

1. Architect will not review submittals that include MSDSs and will return them for resubmittal.

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three (3) copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. “Reviewed”.

2. “Reviewed – Revise As Noted”

3. “Reviewed – Revise and Resubmit”

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

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SECTION 013300a – SUBMITTAL SCHEDULE - Supplement to Submittal Procedures 013300

Final date for submittal submissions is March 13, 2024*. Submittals shall be submitted on a staggered schedule and shall not all be submitted the final day or weeks of submission. This schedule does not surpass any missing items that are required in the construction documents. *See milestone schedule and the construction documents for more information.

CONTRACTOR SUBMITTALS	TEST REPORT/TESTING	CERTIFICATES	COORDINATION DWGS.	DELEGATED DESIGN	MFGR. INSTRUCTIONS	OPER. & MAINT. DATA	SAMPLES	SCHEDULES	SHOP DWGS.	PRODUCT DATA	EXTENDED WARRANTIES	Review Time	Review Notes
033000 CAST-IN-PLACE CONCRETE	x	x							x	x		10	
040120.63 BRICK MASONRY REPAIR	x									x		5	
042000 UNIT MASONRY	x									x		5	
054000 COLD-FORMED METAL FRAMING	x	x	x	x				x	x	x		10	
061000 ROUGH CARPENTRY	x									x		5	
061053 MISCELLANEOUS ROUGH CARPENTRY	x									x		5	
061600 SHEATHING							x			x		5	
064116 PLASTIC LAMINATE-FACED ARCHITECTURAL CABINETS										x		5	
071113 BITUMINOUS DAMPPROOFING	x									x		5	
072100 THERMAL INSULATION	x								x	x		10	
072119 FOAMED-IN-PLACE INSULATION					x					x		5	
072715 NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS	x									x		5	
075113 SEBS MODIFIED BITUMEN ROOFING	x									x		5	
076200 SHEET METAL FLASHING AND TRIM	x	x			x	x	x		x	x	x	10	1
077200 ROOF ACCESSORIES	x	x	x	x	x	x	x		x	x	x	10	
078413 PENETRATION FIRESTOPPING													
079200 JOINT SEALANTS	x	x					x	x		x	x	5	
083113 ACCESS DOORS AND FRAMES							x	x	x	x		5	

CONTRACTOR SUBMITTALS	TEST REPORT/TESTING	CERTIFICATES	COORDINATION DWGS	DELEGATED DESIGN	MFGR. INSTRUCTIONS	OPER. & MAINT. DATA	SAMPLES	SCHEDULES	SHOP DWGS.	PRODUCT DATA	EXTENDED WARRANTIES	Review Time	Review Notes
084113 ALUMINUM FRAMED ENTRANCES AND STOREFRONTS	x	x		x		x	x	x	x	x	x	15	
087100 DOOR HARDWARE	x	x			x	x		x	x	x	x	15	2
088000 GLAZING	x	x					x	x		x	x	10	
089000 LOUVERS	x						x			x		5	
092116.23 GYPSUM BOARD SHAFT WALL ASSEMBLIES													
092216 NON-STRUCTURAL METAL FRAMING										x		5	
092900 GYPSUM BOARD							x			x		5	
095000 ACOUSTAL CEILINGS							x			x		5	
095123 ACOUSTAL TILE CEILINGS							x			x		5	
096513 RESILIENT BASE AND ACCESSORIES							x			x		5	
096519 RESILIANT TILE FLOORING							x			x		5	
096623 RESINOUS MATRIX TERRAZZO FLOORING							x			x		5	
098413 FIXED SOUND-ABSORPTIVE PANELS	x		x	x			x			x		5	
099113 EXTERIOR PAINTING	x									x		5	
099123 INTERIOR PAINTING	x									x		5	
099600 HIGH PERFORMANCE COATINGS	x						x			x		5	
104416 FIRE EXTINGUISHERS	x									x		5	
123623.13 PLASTIC-LAMINATE-CLAD COUNTERTOPS							x			x		5	
220500 COMMON WORK RESULTS FOR PLUMBING										x		10	3
220513 COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT										x		10	3
220514 PLUMBING SPECIALTIES										x		10	3
220515 PIPING SPECIALTIES										x		10	3
220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING										x		10	3
220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT			x	x						x		10	3
220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT										x		10	3
220700 PLUMBING INSULATION										x		10	3
220719 PLUMBING PIPING INSULATION										x		10	3
220800 COMMISSIONING OF PLUMBING		x										10	3

CONTRACTOR SUBMITTALS	TEST REPORT/TESTING	CERTIFICATES	COORDINATION DWGS	DELEGATED DESIGN	MFGR. INSTRUCTIONS	OPER. & MAINT. DATA	SAMPLES	SCHEDULES	SHOP DWGS.	PRODUCT DATA	EXTENDED WARRANTIES	Review Time	Review Notes
221100 FACILITY WATER DISTRIBUTION			x							x		10	3
221116 DOMESTIC WATER PIPING			x							x		10	3
221119 DOMESTIC WATER PIPING SPECIALTIES						x				x		10	3
221123A DOMESTIC WATER CIRCULATION PUMPS						x				x		10	3
221316 SANITARY WASTE AND VENT PIPING			x							x		10	3
221319 SANITARY WAST PIPING SPECIALTIES						x				x		10	3
221329 SANITARY SEWERAGE PUMPS						x				x		10	3
221413 FACILITY STORM DRAINAGE PIPING			x									10	3
221423 STORM DRAINAGE PIPING SPECIALTIES						x				x		10	3
223000 PLUMBING EQUIPMENT													
223400 FUEL-FIRED WATER HEATERS AND STORAGE TANKS						x				x		10	3
224000 PLUMBING FIXTURES						x				x		10	3
224200 COMMERCIAL PLUMBING FIXTURES						x				x		10	3
230500 COMMON WORK RESULTS FOR HVAC										x		10	3
230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT										x		10	3
230514 VARIABLE FREQUENCY DRIVES										x		10	3
230515 PIPING SPECIALTIES										x		10	3
230519 METERS AND GAGES FOR HVAC PIPING										x		10	3
230523 GENERAL-DUTY VALVES FOR HVAC PIPING										x		10	3
230529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT			x	x						x		10	3
230548 VIBRATION AND SEISMIC CONTROLS FOR HVAC AND EQUIPMENT			x	x						x		10	3
230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT										x		10	3
230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC	x	x					x					10	3
230700 HVAC INSULATION										x		10	3
230800 COMMISSIONING OF HVAC		x										10	3

CONTRACTOR SUBMITTALS	TEST REPORT/TESTING	CERTIFICATES	COORDINATION DWGS	DELEGATED DESIGN	MFGR. INSTRUCTIONS	OPER. & MAINT. DATA	SAMPLES	SCHEDULES	SHOP DWGS.	PRODUCT DATA	EXTENDED WARRANTIES	Review Time	Review Notes
HVAC – ALLEN/WALDO													
230914 PNEUMATIC AND ELECTRIC INSTRUMENTATION AND CONTROL DEVICES FOR HVAC						x			x	x		10	3
230923 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC						x			x	x		10	3
230993 SEQUENCE OF OPERATION FOR HVAC CONTROLS						x			x	x		10	3
231100 FACILITY FUEL PIPING			x							x		10	3
231123 FACILITY NATURAL-GAS PIPING			x							x		10	3
232113 HYDRONIC PIPING			x									10	3
232116 HYDRONIC PIPING SPECIALTIES						x				x		10	3
232123 HYDRONIC PUMPS						x				x		10	3
232300 REFRIGERANT PIPING										x		10	3
232500 HVAC WATER TREATMENT										x		10	3
233100 HVAC DUCTS AND CASINGS										x		10	3
233113 METAL DUCTS			x							x		10	3
233300 AIR DUCT ACCESSORIES						x				x		10	3
233400 HVAC FANS						x				x		10	3
233423 HVAC POWER VENTILATORS						x				x		10	3
233600 AIR TERMINAL UNITS										x		10	3
233713 DIFFUSERS, REGISTERS, AND GRILLES										x		10	3
234100 PARTICULATE AIR FILTRATION										x		10	3
235100 BREECHING, CHIMNEYS, AND STACKS										x		10	3
235200 HEATING BOILERS										x		10	3
235239 FIRE TUBE BOILERS						x				x		10	3
235700 HEAT EXCHANGERS FOR HVAC						x				x		10	3
236423 AIR COOLED CHILLERS						x				x		10	3
236426 SCREW CHILLERS			x			x				x		10	3
237313 CENTRAL STATION AIR HANDLING UNITS			x			x				x		10	3
237413 PACKAGED, OUTDOOR, ROOFTOP UNITS			x			x				x		10	3
237413 ROOF TOP AIR HANDLING UNITS			x			x				x		10	3
237433 DEDICATED OUTDOOR-AIR AND MAKE-UP AIR UNITS			x			x				x		10	3
238200 HEATING AND COOLING TERMINAL UNITS			x			x				x		10	3
238123 COMPUTER-ROOM AIR-CONDITIONERS						x				x		10	3
238219 FAN COILS						x				x		10	3
238219.1 BLOWER COILS						x				x		10	3

CONTRACTOR SUBMITTALS	TEST REPORT/TESTING	CERTIFICATES	COORDINATION DWGS	DELEGATED DESIGN	MFGR. INSTRUCTIONS	OPER. & MAINT. DATA	SAMPLES	SCHEDULES	SHOP DWGS.	PRODUCT DATA	EXTENDED WARRANTIES	Review Time	Review Notes
238223 UNIT VENTILATORS						x				x		10	3
238233 CONVECTORS						x				x		10	3
238239 UNIT HEATERS						x				x		10	3
CONTRACTOR SUBMITTALS	TEST REPORT/TESTING	CERTIFICATES	COORDINATION DWGS	DELEGATED DESIGN	MFGR. INSTRUCTIONS	OPER. & MAINT. DATA	SAMPLES	SCHEDULES	SHOP DWGS.	PRODUCT DATA	EXTENDED WARRANTIES	Review Time	Review Notes

SUBMITTAL CONCURRENT REVIEW NOTES	
1	Roofing and Metal trim – submit for a coordinated review (under separate transmittals).
2	Doors and Hardware - submit for a coordinated review (under separate transmittals).
3	All mechanical and plumbing submittals to be submitted in their entirety on the date indicated on the Milestone schedule.

END OF 013300a

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Contractor Qualifications
   1. General Contractors shall be required to fill out and submit an AIA Document A305: Contractor's Qualification Statement with their bid submittal. A General Contractor shall have experience in the construction of a minimum of (3) similar facilities and have been in business with good standing for at least (5) years. The General Contractors site superintendant shall be required to have had experience in the construction and coordination of at least (3) similar facilities.

C. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

D. See Divisions 02 through 49 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and

completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
   2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

   1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five (5) previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Mockups: Are Required. Mechanical equipment in mockups to be powered, operational, and balanced at time of mockup review. Heating and cooling need not be active at the time of review.

1. Cowherd Middle School
   a. Not Required

J. Laboratory Mockups: Not Required

1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.7 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 – REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

J. “Substantial Completion”: is the stage when a construction project is deemed sufficiently completed to the point where the owner can use it for its intended purpose.

K. “Final Completion”: the date determined and certified by A/E and Owner on which the Work is fully and satisfactorily complete in accordance with the Contract.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. See Division 01 Section "Execution" for progress cleaning requirements.

C. See Divisions 02 through 49 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Water Service: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its

use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement: Comply with Division 32 pavement Sections.

B. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 8 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails

C. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 8 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete or galvanized steel bases for supporting posts.

D. Wood Enclosure Fence: Plywood, **6 feet (1.8 m)** high, framed with four 2-by-4-inch (50-by-100-mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.

E. Lumber and Plywood: Comply with requirements in Division 06 Carpentry Sections.

F. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.

G. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

H. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).

I. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of eight (8) at each return air grille in system and remove at end of construction. Permanent HVAC System must be shut down whenever work activities causing excessive airborne particulates (i.e., dust, smoke, etc.). The trade causing or requesting the shut down shall first obtain approval from the CM and coordinate with the General Trades Prime Contractor and Mechanical Contractor to ensure proper maintenance, shut down and operation of the HVAC System.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. Not required

3.3 SUPPORT FACILITIES INSTALLATION

A. Not required

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Pest Control: Employ practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

B. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
3. Provide a Knox-Box with one set of keys for access to the site by other Prime Contractors and security personnel, police and fire departments.

C. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

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SECTION 015611 – GENERAL DUST, FUME, AND ODOR CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Dust Control.

B. Fume and Odor Controls.

C. Requirements for VOC-Content-Restricted products.

1.2 PERFORMANCE STANDARD

A. Dust and fume emission control is required to maintain a healthful learning environment for students, maintain good public relations with neighbors and employees, prevent damage, minimize cleaning and maintenance costs, and to comply with regulations and laws. All contractors (including subcontractors, lower-tier subcontractors, and suppliers) who perform work or provide services at East Aurora School facilities are required to control dust and fume emissions from their operations and/or activities.

B. Controls include the containment or removal of all nuisance or noxious dust, vapors, fumes, odors or emissions caused by construction, demolition, renovation, restoration, or related activities including, but not limited to sawing, cutting, grinding, sanding, abrading, sweeping, crushing, scraping, gluing, prying, plowing, heating, finishing, painting, welding, torch cutting or burning, or any other related processes that can create noxious dust, fumes or odors.

C. No visible emissions or unreasonable odors shall be permitted outside the work area.

1.3 DEFINITIONS

A. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

B. CDPH: Kane County Department of Public Health

C. HEPA Filter: High Efficiency Particulate Air filter capable of trapping 99.97% percent of particles greater than 0.3 micrometers in mass median aerodynamic equivalent diameter.

D. IDPH: Illinois Department of Public Health.

E. Interior of Building: Anywhere inside the exterior weather barrier.

F. MEC: Managing Environmental Consultant. Entity engaged by the Board responsible for the design of environmental work, maintenance of related documents, and conducting oversight and review of the environmental work, submittals, and reports.

G. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

H. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings.
   2. Interior adhesives and sealants, including flooring adhesives.
   3. Wet-applied roofing and waterproofing.
   4. Other products when specifically stated in the specifications.

1.4 REFERENCE STANDARDS

A. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

B. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

C. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

D. 40 CFR 61 - National Emission Standards For Hazardous Air Pollutants; U.S. Environmental Protection Agency; current edition.

E. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).

F. International Building Code 2015

G. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).

H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

C. Safety Data Sheets (SDS): For all products used that could potentially emit dusts, fumes, vapors or odors, etc. shall be submitted to the Project Environmental Coordinator, MEC, and/or Board's Representative for approval prior to the use of the product.

1.6 QUALITY ASSURANCE

A. Contractor is responsible for compliance with all applicable federal, state, county and municipal laws, regulations and ordinances including, but not limited to, those listed below, which are incorporated by reference.
   1. 29 CFR 1910

2. 29 CFR 1926
3. 40 CFR Part 61

B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
      b. Published product data showing compliance with requirements.
      c. Certification by manufacturer that product complies with requirements.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   1. Adhesives and Sealants, Including Flooring Adhesives: SCAQMD 1168 Rule.
      a. Wood Glues: 30 g/L.
      b. Metal to Metal Adhesives: 30 g/L.
      c. Adhesives for Porous Materials (Except Wood): 50 g/L.
      d. Subfloor Adhesives: 50 g/L.
      e. Plastic Foam Adhesives: 50 g/L.
      f. Carpet Adhesives: 50 g/L.
      g. Carpet Pad Adhesives: 50 g/L.
      h. VCT and Asphalt Tile Adhesives: 50 g/L.
      i. Cove Base Adhesives: 50 g/L.
      j. Gypsum Board and Panel Adhesives: 50 g/L.
      k. Rubber Floor Adhesives: 60 g/L.
      l. Ceramic Tile Adhesives: 65 g/L.
      m. Multipurpose Construction Adhesives: 70 g/L.
      n. Fiberglass Adhesives: 80 g/L.
      o. Contact Adhesive: 80 g/L.
      p. Structural Glazing Adhesives: 100 g/L.
      q. Wood Flooring Adhesive: 100 g/L.
      r. Structural Wood Member Adhesive: 140 g/L.
      s. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
      t. Top and Trim Adhesive: 250 g/L.
      u. Plastic Cement Welding Compounds: 350 g/L.
      v. ABS Welding Compounds: 400 g/L.
      w. CPVC Welding Compounds: 490 g/L.
      x. PVC Welding Compounds: 510 g/L.
      y. Adhesive Primer for Plastic: 650 g/L.
      z. Sheet Applied Rubber Lining Adhesive: 850 g/L.

aa. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
bb. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
cc. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
dd. Other Adhesives: 250 g/L.
ee. Architectural Sealants: 250 g/L.
ff. Non-membrane Roof Sealants: 300 g/L.
gg. Single-Ply Roof Membrane Sealants: 450 g/L.
hh. Other Sealants: 420 g/L.
ii. Sealant Primers for Nonporous Substrates: 250 g/L.
jj. Sealant Primers for Porous Substrates: 775 g/L.
kk. Modified Bituminous Sealant Primers: 500 g/L.
ll. Other Sealant Primers: 750 g/L.

2. Paints and Coatings: SCAQMD 1113 Each color; most stringent of the following:
   a. Flat Paints and Coatings: VOC not more than 50 g/L.
   b. Nonflat Paints and Coatings: VOC not more than 150 g/L.
   c. Primers: VOC not more than 50 g/L.
   d. Anti-corrosive and Anti-rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
   e. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
   f. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
   g. Floor Coatings: VOC not more than 100 g/L.
   h. Shellacs, Clear: VOC not more than 730 g/L.
   i. Shellacs, Pigmented: VOC not more than 550 g/L.
   j. Stains: VOC not more than 250 g/L.
3. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.
4. Composite Wood and Agrifiber Products: May not contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 BARRIERS OR WORK AREA ISOLATION

A. Contractor shall prevent the spread of dust, fumes and odors from their immediate work areas by:
   1. Erecting dust-tight barriers between indoor work areas and adjacent occupied areas. Construction barriers may be used for this purpose if suitably constructed to prevent dust, fume or odor migration.
   2. Closing and or covering windows, intake vents, louvers, or other building openings in the immediate vicinity of outdoor work, sufficient to prevent dust, fume or odor migration into the building interior. If such openings cannot be adequately sealed by closing, then poly sheeting, tape, or other impermeable covers shall be used.
   3. The Contractor shall provide a filtered, local exhaust system for the isolated work area.

B. Contractor is prohibited from creating other hazardous or uncomfortable conditions for building occupants, such as very hot, humid, cold, or other conditions created by ventilation system alterations or blockages, closed or open windows in hot or cold weather conditions.

C. Contractor is responsible for making itself familiar with building conditions and shall take care to isolate its work area in such a manner that building occupant activities and comfort are not unreasonably disrupted.

3.2 DUST, FUME AND ODOR CONTROL

A. Dust, fume or odor release shall be prevented by a suitable means, including but not limited to:
   1. Tools equipped with shrouds, HEPA filter equipped vacuum pickups.
   2. Alteration, shut down, or isolation of building ventilation systems in the immediate work vicinity.
   3. Shrouding around work activities.
   4. Shrouding stages, scaffolds, or other work platforms.
   5. Local exhaust ventilation systems exhausted to the outside of the building.
   6. Wet work methods.

B. Contractor is responsible for selecting the means and methods it considers most suitable to achieve dust, fume and odor control.

3.3 FIELD QUALITY CONTROL

A. Board reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Board.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

C. In the event that dust or fumes escape from the work area or create dirty conditions or contamination to nearby building spaces or grounds, the Contractor is responsible for all costs associated with the cleaning, testing and/or repair deemed necessary by the Board's Representative.

END OF SECTION 015611

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.

C. See Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    j. Cost information, including a proposal of change, if any, in the Contract Sum.
    k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.

    a. Form of Acceptance: Change Order.

b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. All warranties shall be for 24 months from the date of Substantial Completion, unless a longer time period is required.

B. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

C. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements. . Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified 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 provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

D. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within sixty (60) days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive 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 (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Division 01 Section "Summary" for limits on use of Project site.
2. Division 01 Section "Submittal Procedures" for submitting surveys.
3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Division 02 Section "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 sustainable design requirements Section.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Division 01 Section "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as

practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.
3. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

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SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. See Divisions 2 through 42 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least ten (10) days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

B. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. N/A

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

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SECTION 017400 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.

1. Each Contractor as listed on the schedule of values shall provide, at a minimum, a written two-year warranty (refer to section 1.4 for items requiring a longer warranty duration) on their respective letterhead for material, workmanship defects. The warranty shall provide a description of the work, list company contact and phone number and be signed by an officer of the Company.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENT

A. Existing Warranties: All LED lighting in the areas depicted in Blue in (Warranty – Exhibit N) are to be considered under manufacturer's warranty.

1. Any fixtures that are located adjacent to the areas that require the installation of pipe chases, ventilation ducting and/or bulk-heads, will be relocated by another vendor to accommodate the new construction by Contractor.

2. In the event Contractor causes damage to the existing lighting fixtures or any of the adjacent areas during the demolition or new construction, Contractor shall bear the entire cost of correcting all damage resulting from neglect, mishaps, damage (intentional or unintentional) or non-conformance with contract documents.

B. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

E. Owner's Recourse: Expressed warranties made to the Owner/SP are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

F. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

G. Mechanical systems shall be provided with a twenty-four (24) month parts and labor warranty, including for equipment purchased by others.

1.5 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for

warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

C. Refer to Divisions 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.
3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

E. Owner reserves the right to conduct a final walkthrough of the building during the twenty-second (22nd) month of the twenty-four (24) month warranty period. Owner shall submit a written list of deficiencies to the Contractor and Contractor shall complete all warranty work prior to the expiration of the twenty-four (24) month warranty period.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 017400

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SECTION 017413 - CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. General Requirements

B. Disposal Requirements

1.2 GENERAL REQUIREMENTS

A. Execute cleaning during progress of the work and at completion of the work.

1.3 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 DURING CONSTRUCTION

A. Execute daily cleaning to keep the work and the site, free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations. This includes daily sweeping of all work areas to keep dust and dirt accumulations down during construction. If it is necessary to perform these daily tasks the general contractor shall provide a staff member(s) to execute this task.

B. Direct all subcontractors to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts. If the subcontractors do not perform as specified, it is the general contractor’s responsibility to execute what is required.

C. Provide onsite containers for the collection of waste materials, debris and rubbish. All waste materials including containers, food debris and other miscellaneous materials must be disposed of daily in onsite containers.

D. Remove waste materials, debris and rubbish from the site weekly or more if needed and dispose of at legal disposal areas away from the site.

3.2 FINAL CLEANING

A. Requirements: At the completion of work/ the turnover of spaces and immediately prior to final inspection, clean the entire project as follows:

1. Thoroughly clean, sweep, wash, and polish all areas affected by the scope of work and equipment provided under the Contract, including finishes.

2. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.

3. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.

B. The General Contractor shall hire a professional cleaning company to perform final cleaning to be completed prior to final ROE inspection

C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.

E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.

F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

G. Replace construction filters in all units with the specified filters.

H. Clean ducts, blowers, and coils, if air-handling units.

I. Vacuum clean all interior spaces, including inside cabinets and lockers.

J. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

K. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

L. Clean interior of all panel cabinets, pull boxes, and other equipment enclosures.

M. Wash and wipe clean all lighting fixtures, lamps, and other electrical equipment which may have become soiled during installation.

N. Perform touch-up painting.

O. Broom clean exterior paved surfaces or hire a street sweeper to clean parking lots to their original cleaned condition; rake clean other surfaces of the ground. Screws/Nails and other foreign objects that remain on the parking lot that damage staff tires after final completion will be at the cost of the General Contractor.

P. Remove erection plant, tools, temporary structures and other materials.

Q. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

3.3 FINAL INSPECTION

A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the OWNER and ARCHITECT.

END OF SECTION 017413

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:
1. Division 02 Section "Selective Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements.
2. Division 04 Section "Unit Masonry" for disposal requirements for masonry waste.
3. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Division 01 Section "Temporary Facilities and Controls."

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.
6. Attic Stock.
7. Closeout Procedures Schedule.

B. Related Requirements:
1. Division 01 Section "Execution" for progress cleaning of Project site.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
5. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBMITTALS

A. Before Final Payment is approved, the Contractor shall submit electronically in PDF format via Submittal Exchange (www.submittalexchange.com) to the Architect including documentation as note in the following sections:

1. Closeout Procedures
2. Operation and Maintenance Data

3. Project Record Documents
4. Product Data: For cleaning agents.
5. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion
6. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 working days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.

6. Submit sustainable design submittals required in Division 01 sustainable design requirements Section and in individual Division 02 through 33 Sections.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

Note: Contractor to comply with Section 00500 Supplementary Conditions: Article 9 Payments and Completion, Section 9.8.3.1.

3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

1.7 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

Note: Contractor to comply with Section 00500 Supplementary Conditions: Article 9 Payments and Completion, Section 9.10.1.1.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:
    a. PDF electronic file. Architect will return annotated file.

1.9 WARRANTIES

A. All warranties shall be for 24 months from the date of Substantial Completion unless a longer time period is required.

B. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

C. Partial Occupancy: Submit properly executed warranties within 10 working days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

D. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Remove tools, construction equipment, machinery, and surplus material from Project site.
d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
f. Sweep concrete floors broom clean in unoccupied spaces.
g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
i. Remove labels that are not permanent.
j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

k. Wipe surfaces of mechanical and electrical equipment**,** elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Replace parts subject to unusual operating conditions.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

    1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
p. Leave Project clean and ready for occupancy.

C. Pest Control: Make a final inspection and rid Project of rodents, insects, and other pests.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous

materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 SUBMITTALS

A. Manual: Submit electronically in PDF format via Submittal Exchange (www.submittalexchange.com) each manual in final form at least fifteen (15) days before final inspection. Architect will return copy with comments within fifteen (15) days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit electronically in PDF format each corrected manual within fifteen (15) days of receipt of Architect's comments.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
b. Enable inserted reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Architect.
7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Requirements:
1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal: Submit electronically in PDF format via Submittal Exchange (www.submittalexchange.com). marked-up Record Prints. Architect will initial and date each set and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. Architect will return prints for organizing into sets, printing, binding, and final submittal.
b. Final Submittal: Submit electronically in PDF format via Submittal Exchange marked-up Record Prints, and the following:

B. Record Specifications: Submit electronically in PDF format via Submittal Exchange Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit electronically in PDF format via Submittal Exchange each Product Data submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect.
    e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training videotapes.

B. See Divisions 02 through 49 Sections Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

A. Instruction Program: Submit electronically in PDF format outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Demonstration and Training Videos: Submit two (2) copies within seven (7) days of end of each training module. Submit electronically via Submittal Exchange (www.submittalexchange.com).

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two (2) copies within seven (7) days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

    a. Name of Project.
    b. Name and address of videographer.
    c. Name of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training.

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable

D. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish an instructor to describe Owner's operational philosophy.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven (7) days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, a written or a demonstration performance-based test.

3.3 DEMONSTRATION AND TRAINING VIDEOS

A. General: Engage a qualified commercial photographer to record demonstration and training videos. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Format: Provide high-quality digital video on DVD.

C. Narration: Describe scenes on video by audio narration by microphone or dubbing audio narration off-site after video is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION 017900

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

EXHIBITS:

EXHIBIT A – BIDDER QUALIFICATION FORMS, CORDOGAN CLARK & ASSOCIATES CONTRACTOR PRE-QUALIFICATION FORM & AIA DOCUMENT NO. A-305, 1986 EDITION (AIA FORMS AVAILABLE AT: http://www.aia.org/contractdocs/index.htm)

EXHIBIT B – STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR, AIA DOCUMENT NO. A-101, 2017 EDITION

EXHIBIT C – GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, AIA DOCUMENT NO. A-201, 2017 EDITION

EXHIBIT D – BID BOND, AIA DOCUMENT NO. A-310, 2010 EDITION

EXHIBIT E – PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND, AIA DOCUMENT NO. A-312, 2010 EDITION

EXHIBIT F – PAYMENT APPLICATION FORMS, AIA DOCUMENT NO. G-702, 1992 EDITION AND AIA DOCUMENT NO. G-703, 1992 EDITION CONTINUATION SHEETS

EXHIBIT G – WORK CHANGES PROPOSAL REQUEST FORM, AIA DOCUMENT NO. G-709, 2001 EDITION

EXHIBIT H – REQUEST FOR INFORMATION (RFI) FORM

EXHIBIT I – ELECTRONIC RELEASE OF LIABILITY FORM

EXHIBIT J – OWNER TAX EXEMPT CERTIFICATE

EXHIBIT K – KANE COUNTY ROE FORMS - CONFIRMATION OF CALLED INSPECTION RECORDS & DOCUMENTATION OF CALLED INSPECTIONS FOR NEW CONSTRUCTION

EXHIBIT L – PROPOSED MILESTONE SCHEDULE – COWHERD MIDDLE SCHOOL

Cordogan, Clark & Associates, Inc.

Contractor Pre-Qualification Form

GENERAL INFORMATION		
	Today's Date:	
1. Company Name:	Telephone:	Fax:
Street Address:	Mailing Address:	
Contact Person:	Web Site:	
Telephone:	E-Mail:	
2. Officers President:	Years with Company:	
Vice President:	Years with Company:	
Secretary:	Years with Company:	
3. How Many Years has Your Organization Been in Business Under Your Present Firm Name?		
4. Form of Business: ❒ Sole Owner ❒ Partnership ❒ Corporation (State Incorporated:)		
5. State License #:	5a. Tax ID#:	5b. Dun's #:
6. Under Current Management Since (Date):		
7. SIC / NAICS Code(s):	8. Specialty Trade(s) Performed:	
9. Parent Company Name:		
City:	State:	Zip:
10. Subsidiaries:		

SAFETY			
11. Does Your Company Have a Written Safety & Health Program? ❒ Yes ❒ No *(If yes, please attach a copy of the Table of Contents.)*			
12. Who is Responsible for Coordinating Your Company's Safety Program?			
Name:	Title:	Telephone:	
13. Describe Your Safety Training for Your Employees:			
- Employee Orientation Training	❒ Yes ❒ No	Frequency:	By Whom:
- Supervisors, Managers	❒ Yes ❒ No	Frequency:	By Whom:
- Jobsite "Tool Box Meetings"	❒ Yes ❒ No	Frequency:	By Whom:
14. Does Your Company Have a Site Specific Safety Program? ❒ Yes ❒ No *(If yes, please attach an example copy.)*			
15. Does Your Company Perform Jobsite Inspections? *(If yes, please attach an example.)*	❒ Yes ❒ No	Frequency:	By Whom:
15a. If Your Company Does not Perform Jobsite Inspections, Explain Why:			
15b. Do You Use An Outside Agency For Site Inspections?	❒ Yes ❒ No	Frequency:	Whom:

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SAFETY (cont'd)

16. Insurance Carrier(s): *(Please attach copy of current insurance certificate.)*

Name	Type of Coverage	Insurance Broker's Contact & Telephone

17. What is Your Company's OSHA Recordable Incident Rate Over the Last Three Years:

Year:			
Rate:			

18. What is Your Company's OSHA Severity or Lost Workday Rate Over the Last Three Years:

Year:			
Rate:			

Please attach copies of your OSHA 300 logs for years listed above. If you do not complete OSHA 300 forms, explain why:

19. What is Your Company's Experience Modification Rate (E. M. R.) Over the Last Three Years:

Year:			
Rate:			

(Please attach a letter from your insurance carrier or state fund (on their letterhead) verifying the E. M. R. data provided.)

20. How Many OSHA Citations / Violations has Your Company Received in the Last Three Years:

(Please provide the details of each citation / violation on a separate sheet of paper and attach.)

INDUSTRY MEMBERSHIP AFFILIATIONS

21. What Industry Organizations / Associations is Your Company a Member of:

21a. What Awards / Special Recognition has Your Company Received:

Signature Block

As a condition of pre-qualification, the said Company agrees that it:

A. Will notify the Owner within five business days of any material changes to the information contained in this form.
B. Authorizes the local broker(s) listed in Item 16 to provide any and all information regarding said Company to the Owner, as a condition of said Company's pre-qualification.

Signature – FORM MUST BE SIGNED BY SAID COMPANY'S PRESIDENT, VICE PRESIDENT or CEO (if Corporation), PARTNER (if partnership), or SOLE OWNER (if sole owner). *I hereby certify that all the information contained in this pre-qualification statement is true and complete, and that I have the authority to execute this document on behalf of this firm.*

Signed:		**Date:**
Name:		**Title:**

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AIA® Document A305™ – 1986

Contractor's Qualification Statement

The Undersigned certifies under oath that the information provided herein is true and sufficiently complete so as not to be misleading.

SUBMITTED TO:

ADDRESS:

SUBMITTED BY:

NAME:

ADDRESS:

PRINCIPAL OFFICE:

[ ] Corporation
[ ] Partnership
[ ] Individual
[ ] Joint Venture
[ ] Other

NAME OF PROJECT: *(if applicable)*

TYPE OF WORK: *(file separate form for each Classification of Work)*

[ ] General Construction
[ ] HVAC
[ ] Electrical
[ ] Plumbing
[ ] Other: *(Specify)*

§ 1 ORGANIZATION

§ 1.1 How many years has your organization been in business as a Contractor?

§ 1.2 How many years has your organization been in business under its present business name?

§ 1.2.1 Under what other or former names has your organization operated?

§ 1.3 If your organization is a corporation, answer the following:

§ 1.3.1 Date of incorporation:

§ 1.3.2 State of incorporation:

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This form is approved and recommended by the American Institute of Architects (AIA) and The Associated General Contractors of America (AGC) for use in evaluating the qualifications of contractors. No endorsement of the submitting party or verification of the information is made by AIA or AGC.

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User Notes: (1801550404)

§ 1.3.3 President's name:
§ 1.3.4 Vice-president's name(s)

§ 1.3.5 Secretary's name:
§ 1.3.6 Treasurer's name:

§ 1.4 If your organization is a partnership, answer the following:
§ 1.4.1 Date of organization:
§ 1.4.2 Type of partnership (if applicable):
§ 1.4.3 Name(s) of general partner(s)

§ 1.5 If your organization is individually owned, answer the following:
§ 1.5.1 Date of organization:
§ 1.5.2 Name of owner:

§ 1.6 If the form of your organization is other than those listed above, describe it and name the principals:

§ 2 LICENSING

§ 2.1 List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable.

§ 2.2 List jurisdictions in which your organization's partnership or trade name is filed.

§ 3 EXPERIENCE

§ 3.1 List the categories of work that your organization normally performs with its own forces.

§ 3.2 Claims and Suits. (If the answer to any of the questions below is yes, please attach details.)
§ 3.2.1 Has your organization ever failed to complete any work awarded to it?

§ 3.2.2 Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against your organization or its officers?

§ 3.2.3 Has your organization filed any law suits or requested arbitration with regard to construction contracts within the last five years?

§ 3.3 Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? (If the answer is yes, please attach details.)

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§ 3.4 On a separate sheet, list major construction projects your organization has in progress, giving the name of project, owner, architect, contract amount, percent complete and scheduled completion date.

§ 3.4.1 State total worth of work in progress and under contract:

§ 3.5 On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of project, owner, architect, contract amount, date of completion and percentage of the cost of the work performed with your own forces.

§ 3.5.1 State average annual amount of construction work performed during the past five years:

§ 3.6 On a separate sheet, list the construction experience and present commitments of the key individuals of your organization.

§ 4 REFERENCES

§ 4.1 Trade References:

§ 4.2 Bank References:

§ 4.3 Surety:

§ 4.3.1 Name of bonding company:

§ 4.3.2 Name and address of agent:

§ 5 FINANCING

§ 5.1 Financial Statement.

§ 5.1.1 Attach a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses);

Net Fixed Assets;

Other Assets;

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Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes);

Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

§ 5.1.2 Name and address of firm preparing attached financial statement, and date thereof:

§ 5.1.3 Is the attached financial statement for the identical organization named on page one?

§ 5.1.4 If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

§ 5.2 Will the organization whose financial statement is attached act as guarantor of the contract for construction?

§ 6 SIGNATURE

§ 6.1 Dated at this day of

Name of Organization:

By:

Title:

§ 6.2

M being duly sworn deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading.

Subscribed and sworn before me this day of

Notary Public:

My Commission Expires:

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Additions and Deletions Report for
AIA® Document A305™ – 1986

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

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There are no differences.

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Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 12:53:02 ET on 04/16/2019 under Order No. 7598231742 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A305™ – 1986, Contractor's Qualification Statement , as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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AIA® Document A101™ – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

East Aurora School District # 131
310 Seminary Avenue, Aurora, IL 60506

and the Contractor:
(Name, legal status, address and other information)

TBD

for the following Project:
(Name, location and detailed description)

The Architect:
(Name, legal status, address and other information)

Cordogan Clark & Associates, Inc.
960 Ridgeway Avenue
Aurora, IL 60506
Phone: 630-896-4678
Fax: 630-896-4987

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

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[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[X] By the following date: TBD

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
	TBD

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be ($), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

See Item 5.1.3.

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the 10th working day before the end of the month, the Owner shall make payment of the amount certified to the Contractor not later than the last day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than Sixty (60) days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. In addition to other required items, each Application for Payment shall be accompanied by the following, all in form and substance satisfactory to the Owner and in compliance with the applicable statutes of the State of Illinois: (i) a current sworn statement of the Contractor setting forth all Subcontractors and any material suppliers, the amount requested for any Subcontractor or material supplier, together with a current, duly executed waiver of liens from the Contractor, Subcontractor, or materials supplier and (ii) any other document reasonably requested by the Architect including, but not limited to, any "after the fact" waivers of mechanics' and material suppliers' liens from all Subcontractors and material suppliers where applicable.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and

.5 Retainage withheld pursuant to Section 5.1.7.

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§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

10% Retainage

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

Reductions of retainage prior to the date specified in the Contract Documents shall be at the discretion of the Owner. Any reduction or release of retainage, or portion thereof, shall not be a waiver of (i) any of the Owner's rights to retainage in connection with other payments to the Contractor or (ii) any other right or remedy that the Owner has under the Contract Documents, at law or in equity.

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%

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ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[X] Litigation in a court of competent jurisdiction

[X] Other *(Specify)*

With the parties having the option to mediate prior to litigation if agreed to by both parties in writing.

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

Steve Megazzini, Assistant Superintendent of Operations
East Aurora School District #131
411 Hill Avenue
Aurora, Illinois 60505
Telephone Number: 630-299-5548

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§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

TBD

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor

.2 Insurance and Bonds – see Item 9.1.9.

.3 AIA Document A201™–2017 & 2007, General Conditions of the Contract for Construction

(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date
See Exhibit "A" – List of Drawings & Specifications		

.6 Specifications

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Section	Title	Date	Pages
See Exhibit "A" – List of Drawings & Specifications			

.7 Addenda, if any:

Number	Date	Pages
TBD		

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[X] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
Specification Section 005000	Supplementary General Conditions		

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

Insurance requirements are as listed in the project Specifications. Payment & Performance Bond's are the full amount of the awarded contract.

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
Dr. Jennifer Norrell, Superintendent	TBD
(Printed name and title)	*(Printed name and title)*

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Additions and Deletions Report for
AIA® Document A101™ – 2017

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

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PAGE 1

AGREEMENT made as of the day of in the year 2019

...

East Aurora School District
417 S. Fifth Street
Aurora, IL 60505
Phone: 630-299-5550
Fax: 630-299-5500

...

TBD

...

Cordogan Clark & Associates, Inc.
960 Ridgeway Avenue
Aurora, IL 60506
Phone: 630-896-4678
Fax: 630-896-4987

PAGE 3

[X] By the following date: TBD

...

TBD

...

PAGE 4

See Item 5.1.3.

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the ~~day of a~~ 10th working day before the end of the month, the Owner shall make payment of the amount certified to the Contractor not later than the last day of the following month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than ~~(~~ Sixty (60) days after the Architect receives the Application for Payment.

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...

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. In addition to other required items, each Application for Payment shall be accompanied by the following, all in form and substance satisfactory to the Owner and in compliance with the applicable statutes of the State of Illinois: (i) a current sworn statement of the Contractor setting forth all Subcontractors and any material suppliers, the amount requested for any Subcontractor or material supplier, together with a current, duly executed waiver of liens from the Contractor, Subcontractor, or materials supplier and (ii) any other document reasonably requested by the Architect including, but not limited to, any "after the fact" waivers of mechanics' and material suppliers' liens from all Subcontractors and material suppliers where applicable.

PAGE 5

10% Retainage

...

Reductions of retainage prior to the date specified in the Contract Documents shall be at the discretion of the Owner. Any reduction or release of retainage, or portion thereof, shall not be a waiver of (i) any of the Owner's rights to retainage in connection with other payments to the Contractor or (ii) any other right or remedy that the Owner has under the Contract Documents, at law or in equity.

PAGE 6

[X] Litigation in a court of competent jurisdiction

[X] Other *(Specify)*

With the parties having the option to mediate prior to litigation if agreed to by both parties in writing.

...

Alberto Tijerina, Director of Buildings & Grounds
East Aurora School District #131
411 Hill Avenue
Aurora, Illinois 60505
Telephone Number: 630-299-8340

PAGE 7

TBD

...

.2 ~~AIA Document A101™–2017, Exhibit A,~~ Insurance and Bonds – see Item 9.1.9.

.3 AIA Document ~~A201™–2017,~~ A201™–2017 & 2007, General Conditions of the Contract for Construction

~~**.4** AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:~~

...

See Exhibit "A" – List of Drawings & Specifications

PAGE 8

See Exhibit "A" – List of Drawings & Specifications

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...

TBD

...

[ ] ~~AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:~~
~~*(Insert the date of the E204-2017 incorporated into this Agreement.)*~~

...

[ ] ~~The Sustainability Plan:~~

~~Title~~	~~Date~~	~~Pages~~

...

[X] Supplementary and other Conditions of the Contract:

...

Specification Section 005000	Supplementary General Conditions		

...

Insurance requirements are as listed in the project Specifications. Payment & Performance Bond's are the full amount of the awarded contract.

...

Dr. Jennifer Norrell, Superintendent

TBD

DRAFT

DRAFT

AIA® Document A201™ – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

East Aurora High School
500 Tomcat Lane, Aurora, IL 60505

THE OWNER:

East Aurora School District # 131
310 Seminary Avenue, Aurora, IL 60506

THE ARCHITECT:
(Name, legal status and address)
The Architect means the architect and/or engineer identified elsewhere in the Contract Documents.

TABLE OF ARTICLES

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12 UNCOVERING AND CORRECTION OF WORK

13 MISCELLANEOUS PROVISIONS

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

DRAFT

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means all of the Contractor's duties under the Contract Documents, including the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker, if any, is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

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§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 If any two or more provisions of the Contract Documents conflict, and such conflict relates to the quantity or quality of the Work, the Contractor agrees to provide the greater quantity and/or better quality of such Work.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the reserved rights claimed by the owner(s) and any licensee(s) who have an interest in and to the Instruments of Service.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the owner(s) and any licensee(s) who have an interest in and to the Instruments of Service.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties may agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. If the parties agree to protocols governing the transmission and use of Instruments of Service and other documents in digital form, the parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish these protocols for the development, use, transmission, and exchange of digital data.

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§ 1.8 Reserved.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall, to the extent allowed by law and by the Owner's policies and procedures, have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 Reserved.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Reserved.

§ 2.2.2 Reserved.

§ 2.2.3 Reserved.

§ 2.2.4 Where the Owner has furnished any information or documents to the Contractor in connection with the Project, the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities. The Contractor shall provide information or other assistance as the Architect or Owner may request in connection with these obligations.

§ 2.3.2 As appropriate for the Project, the Owner shall retain an architect and/or engineer lawfully licensed to practice architecture and/or engineering, or an entity lawfully practicing architecture and/or engineering, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 Reserved.

§ 2.3.4 Upon written request by the Contractor, the Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the

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Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3. The Owner's rights and remedies under this section are in addition to, and not a limitation of, any other rights and remedies of the Owner under the Contract Documents or otherwise.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents or approved construction schedules, and fails within a five-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default, neglect, or failure. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and reasonable attorneys' fees, and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner within thirty (30) days after a request by the Owner.

§ 2.6 Owner's Right to Audit. The Contractor shall keep full and accurate records of all labor and material costs incurred and items billed in connection with the performance of the Work, which records shall be open to inspection, copying, and audit by the Owner or its authorized representatives during performance of the Work and until three years after Final Payment.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative. The Contractor is an independent contractor, and shall not be deemed an agent of the Owner for any reason.

§ 3.1.2 The Contractor shall perform the Work in strict accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in strict accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 The Contractor represents that it has visited the Project site, become generally familiar with local conditions under which the Work is to be performed, correlated personal observations with requirements of the Contract Documents, and has satisfied itself as to the nature and location of the Work, the general and local conditions, including those bearing upon access (including partial or total restrictions on access), transportation, delivery, disposal, staging, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, ground water table or similar physical conditions of the ground, the character, quality and quantity of existing conditions to be encountered, the character of equipment and facilities needed prior to and during the prosecution of the Work and all other matters which can in any way effect the Work or the cost thereof under this Agreement. Any failure by the Contractor to acquaint itself with all the available information concerning these conditions will not relieve the Contractor from any obligation under the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor or its Subcontractors or suppliers as a request for information in such form as the Architect may require.

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It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect and Owner any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.2.5 In all cases where Work interconnects with existing facilities, Contractor shall field measure and verify at the site all dimensions relating to such existing facilities. Any conflicts in the Work and the existing facilities which could have been mitigated by the Contractor's obligation to verify the dimensions of the existing facilities shall be promptly rectified by the Contractor at its own expense, and such obligation does not limit the Owner's other rights and remedies under the Contract Documents.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose to Owner and Architect alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. The Contractor shall not proceed performing the Work using its alternative means, methods, techniques, sequences, or procedures without written approval from the Architect.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.3.4 The Contractor shall coordinate inspections by governmental authorities having jurisdiction over the Work.

§ 3.3.5 No inspection performed or failed to be performed shall be a waiver of any of the Contractor's obligations hereunder.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions

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only with the written consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.4.4 The Contractor shall not at any time permit on the Project site any alcohol or controlled substances whether inside or outside of buildings or structures. Possession or use of any of the foregoing at or adjacent to the site shall obligate the Contractor to remove such offending personnel from the site and replace them at no additional cost to the Owner.

§3.4.5 The Contractor and any Subcontractors shall conform to labor laws of the State and various acts amendatory and supplementary thereto and to other laws, ordinances and legal requirements applicable thereto. Contractor shall enforce among all personnel directly or indirectly employed by it, and among all Subcontractors and their employees, all rules which the Owner may establish for conduct of such personnel on the site.

§3.4.6 The Contractor shall pay prevailing wages in accordance with and shall fully comply with all requirements of the Prevailing Wage Act, 820 ILCS 130/0.01, *et seq.* This Agreement calls for the construction of a "public work," within the meaning of the Illinois Prevailing Wage Act, 820 ILCS 130/.01 et seq. ("the Act"). The Act requires contractors and subcontractors to pay laborers, workers and mechanics performing services on public works projects no less than the current "prevailing rate of wages" (hourly cash wages plus amount for fringe benefits) in the county where the work is performed. The Department publishes the prevailing wage rates on its website at http://labor.illinois.gov/. The Department revises the prevailing wage rates and the contractor/subcontractor has an obligation to check the Department's web site for revisions to prevailing wage rates. For information regarding current prevailing wage rates, please refer to the Illinois Department of Labor's website. All Contractors, Subcontractors, and sub-subcontractors rendering services under this Agreement must comply with all requirements of the Act, including but not limited to, all wage requirements and notice and record keeping duties.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work shall strictly conform to the requirements of the Contract Documents and shall be free from defects. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Owner is tax-exempt. Notwithstanding, the Contractor shall pay any applicable sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

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§ 3.7.3 If the Contractor performs Work contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall immediately notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection. Notwithstanding any provision of the Contract Documents to the contrary, any use of an allowance account is subject to the written pre-approval of the Owner.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work on site. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. The superintendent shall be subject to approval by the Owner and shall not be replaced without the prior written consent of the Owner. The Owner shall have the right to require that the Contractor replace the superintendent, at no additional cost to the Owner, at any time during the duration of the Work if his/her performance is not satisfactory to the Owner.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Owner or Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to

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the proposed superintendent or (2) requires additional time for review. Failure of the Owner and Architect to provide notice within the 14-day period shall constitute notice of no initial objection, but shall not affect Owner's right to make a subsequent rejection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.1.1 The Contractor's construction schedules shall be in a bar chart format, and shall depict, at a minimum, activity identification and durations, critical path, float, early start, early finish, late start, and late finish.

§ 3.10.1.2 The float in the construction schedules will not be deemed exclusively available to the Contractor or Owner, but rather shall be available to either party as needed.

§ 3.10.1.3 No less than once per month, the Contractor shall submit an updated construction schedule. The updated construction schedule shall depict actual start and completion dates for Work commenced and, if appropriate, Work completed. Additionally, the updated construction schedules shall depict updated estimates of anticipated commencement and completion dates for all upcoming Work.

§ 3.10.1.4 The Contractor's submission of the initial construction schedule and monthly schedule updates shall be conditions precedent to certification of the Contractor's application for payment.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect. If the Contractor fails to adhere to the approved construction schedule(s), Contractor shall immediately, at its own expense, take necessary measures to remedy such failure, including addition of personnel and/or equipment, overtime, and/or additional shifts. The Owner shall be entitled to rely on Contractor's schedules for coordination of its own activities, as well as the activities of other contractors working at the Project site or on the Project.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals (collectively the "As-Built Documents"). These As-Built Documents shall be in electronic form or paper copy, available for inspection by the Architect or Owner upon reasonable notice, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed. Adequate maintenance of the As-Built Documents shall be a condition precedent to certification of the Contractor's applications for payment.

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§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if

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prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Architect has specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to the site access plan, if any, and to the areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project. Throughout the progress of the Work the Contractor shall continually remove from the Project Site and from any adjacent property, all waste, scraps, tools, equipment, storage facilities, machinery, trailers, and vehicles no longer required for prosecution of the Work, such that the Project site remains clean, orderly, and safe.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, or the Contractor has reason to believe that the required design, process, or product is an infringement, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees and litigation expenses (including expert witness fees), arising out of or resulting from performance of the Work, but only to the extent caused by Contractor's breach

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of contract or by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

§ 3.18.3 "Claims, damages, loses and expenses" as these words are used herein shall be construed to include, but not be limited to (1) injury or damage resulting from the failure of or use or misuse by Contractor, its Subcontractors, agents, servants or employees, of any hoist, rigging, blocking, scaffolding, or any and all other kinds of items of equipment, whether or not the same be owned, furnished or loaned by Owner; (2) all attorneys' fees and costs incurred in defense of the claim or in bringing an action to enforce the provision of this Indemnity or any other indemnity contained in the Contract Documents, including the fees charged by the indemnitee's expert witnesses; and (3) all costs, expenses, lost time, opportunity costs and other similar indirect or incident damages incurred by the party being indemnified or its employees, agents or consultants.

§ 3.18.4 In the event that the Contractor or its Subcontractors are requested to, but refuse to, honor the indemnity obligations hereunder or to provide a defense, then in addition to all other obligations hereunder, the Contractor and its Subcontractors shall reimburse the Owner and Architect the cost of any legal action concerning Contractor's or Subcontractor's duty to defend and indemnify under this Agreement, including attorneys' fees, time expended, costs and expenses.

§ 3.18.5 The Contractor hereby knowingly and intentionally waives the right to assert, under the case of *Kotecki v. Cyclops Welding Corp*., 146 Ill.2nd 155 (1991) that Contractor's liability may be limited to the amount of its statutory liability under the Workers' Compensation Act, and agrees that Contractor's liability to indemnify and defend the Owner and Architect is not limited by the so called "Kotecki Cap". The Contractor shall include this provision in each of its Subcontract agreements and shall require its Subcontractors to be so bound.

§ 3.18.6 The Contractor shall include in each and every Subcontract with any and all Subcontractors and/or material suppliers performing Work and require each and every Subcontractor and/or material supplier performing Work to agree to be bound by all of the provisions 3.18.1 through 3.18.10 under the Contract Documents.

§ 3.18.7 The Contractor's indemnity obligations hereunder shall specifically include all claims and judgments which may be made against the indemnitees under federal or state law or the law of the other governmental bodies having jurisdiction, and further, against claims and judgments arising from violation of public ordinances and requirements of governing authorities due to Contractor's or Contractor's employees' method of execution of the Work.

§ 3.18.8 The provisions of this Section 3.18 are not intended to conflict in any way with the Construction Contract Indemnification for Negligence Act, 740 ILCS 35/0.01 *et seq*. and shall be interpreted in accordance therewith.

§ 3.18.9 The Contractor shall indemnify and hold harmless the Owner in the event of labor or trade union conflicts or disputes between the Contractor and Subcontractors and their respective employees. The Contractor shall endeavor to adjust and resolve such conflicts and disputes which affect the timely completion of the Work. Such conflicts or disputes shall not be a basis or excuse for the breach of the Contract Documents by the Contractor or its Subcontractors, and shall not provide the Contractor with relief from complying with dates for Substantial Completion or Final Completion. Labor or trade union disputes that affect production or delivery of materials or equipment, or the installation, shall be at no cost to the Owner. The Contractor shall notify the Architect and the Owner in writing as soon as possible as to any labor or trade disputes which may affect the Work and its timely completion. In such event, the Contractor shall provide a written proposal to the Architect and the Owner which includes any comparable substitution(s) necessary to complete the Work.

§ 3.18.10 None of the foregoing provisions shall deprive the Owner or the Architect of any action, right or remedy otherwise available to them or either of them at law.

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§ 3.19 If the Work is to be performed by trade unions, the Contractor shall make all necessary arrangements to reconcile, without delay, damage, or cost to the Architect or the Owner, any conflict between the Contract Documents and any agreements or regulations of any kind at any time in force among members or councils which regulate or distinguish what activities shall not be included in the Work of any particular trade. Such arrangements are subject to written pre-approval of Owner and Architect. In case the progress of the Work is affected by any undue delay in furnishing or installing any items or materials or equipment required under the Contract Documents because of the conflict involving any such agreement or regulation, the Architect may require that other material or equipment of equal kind and quality be provided at no additional cost to the Owner.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement or the Contract Documents.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall endeavor to include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect and the Owner each have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Owner or Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

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§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance of the information given with the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The authority of the Architect's Project representative is limited by the Owner's policies and procedures, and by the terms and conditions of the agreement between the Owner and Architect. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents and if approved in writing by the Owner.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 If this Project is utilizing a construction manager at-risk, then when the lowest, responsive and responsible multiple prime trade bidder(s) are identified and awarded contracts by the Owner, each such award shall constitute the automatic assignment of that trade contract by the Owner to the construction manager, who is also known as the "Contractor". Each such successful bidder shall then be known as a "Subcontractor." If this Project is utilizing a single general contractor or multiple prime trade contractors, and the Project is not utilizing a construction manager-at risk, then there shall be no such assignment. In any case, a Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

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§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Reserved.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect.

Each Subcontractor acknowledges: (1) that the Owner is a direct intended third party beneficiary of each Subcontract between the Contractor and Subcontractor; (2) that notwithstanding any contract provision to the contrary, Subcontractor shall be bound to perform the Work in accordance with these AIA A201 General Conditions, as amended; and (3) that the Subcontractor is not a third party beneficiary of any contract between Contractor and Owner.

Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner, and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Reserved.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity, and upon such further assignment, the Owner shall have no further liability to such subcontractor.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project or other construction or operations on the site with the Owner's own forces, and with Separate Contractors. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

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§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. Subject to Article 15, 5he Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 Reserved.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 The Owner may, without invalidating the Contract and without notice to the surety, direct changes in the Work. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.1.4 No Change Order shall be approved or paid unless preceded by a written direction for the Change Order is provided by the Owner. This requirement cannot be waived by conduct, custom, or practice with respect to this Project or other projects. There shall be no implied or constructive change orders.

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§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 No payment for changes in the Work shall be made until such change has been memorialized in an executed Change Order and the Change has been executed.

§ 7.2.3 If the Contractor is also the Project's Construction Manager pursuant to a separate construction management agreement with the Owner, the Contractor shall not be permitted any markup on Change Orders or compensation with respect to Change Orders, other than as may be provided in such construction management agreement. The Subcontractors, and any Contractor who is not serving as Construction Manager for the Project, shall be entitled to the following markups for additive Changes Orders, and shall be required to take the following mark-downs for deductive Change Orders. Additional markup for insurance or bonds will not be allowed. All Change Order requests must be submitted with the following backup information or they will not be reviewed or processed by the Architect or Owner: material and labor quantities, material unit costs, labor rates, and any other substantiating data to explain and substantiate the Change Order amount.

Markups and Markdowns for Change Orders:

Additive Change Order: 10%
Deductive Change Order: 10%

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order for the purposes of defining the change and/or how any payment shall be calculated, but not for the purpose of approving payment.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in Section 7.2.3. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

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.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Upon execution by the Owner, such agreement shall be effective and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase or net decrease, if any, with respect to that change.

§ 7.3.9 Reserved.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

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§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time. The Contractor shall achieve Final Completion within thirty (30) days following Substantial Completion.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by a cause that (1) was reasonably unforeseeable to the Contractor; and (2) is not within the Contractor's control, , then the Contract Time shall be equitably extended and such extension shall be reduced to a Change Order.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 Extension of Contract Time pursuant to this Article 8 shall be the Contractor's sole and exclusive remedy for delay.

§ 8.3.4 Extension of Contract Time resulting from Changes in the Work shall be negotiated into respective Change Orders. Whenever the Contractor seeks an adjustment in the Contract Time as part of a Claim or Change Order, the Contractor shall justify the request with proper written reference to the approved construction schedules. All executed Change Orders shall be deemed to include adjustments in the Contract Time, if any, resulting from the underlying Change in the Work.

§ 8.3.5 In addition to other rights and remedies set forth elsewhere in the Contract Documents, the Contractor shall reimburse the Owner for all Architect's fees and expenses for additional services necessitated by (1) Contractor's failure to achieve Substantial Completion within the time established in the Contract Documents; (2) for more than one inspection to determine Substantial Completion; and (3) for more than one inspection to determine Final Completion.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents. If the Contractor is also the construction manager pursuant to a construction management agreement with the Owner, that agreement contains any and all additional compensation payable to the Contractor in its role as construction manager.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated for any one item of material or equipment are changed by more than 25% in a proposed Change Order or Construction Change Directive, the applicable unit prices shall be equitably adjusted in such Change Order or Construction Change Directive.

§ 9.2 Schedule of Values

The Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various Subcontracts. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. Each section of the schedule organized by Subcontract shall further allocate each Subcontractor's Work into discrete tasks with values corresponding to each task. The total of all values for all tasks for all Subcontractors shall equal the Contract Sum. Portions of the Work not subcontracted shall be allocated into discrete tasks and corresponding values. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment. Approval by the Owner of the schedule of values (and revisions thereto) shall be a condition precedent to certification of Contractor's applications for payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, including copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if

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provided for in the Contract Documents. The Contractor's inclusion in an Application for Payment of an amount owed to a Subcontractor shall constitute the Contractor's certification to the Owner that such Subcontractor is entitled to payment in that amount, and that there are no backcharges, Claims, or other disputes then pending or anticipated which may impact that Subcontractor's right to such payment. Contractor shall submit all Applications for Payment in a consistent format.

§ 9.3.1.1 Such applications may include requests for payment on account of changes in the Work that have been properly authorized by Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor has not approved payment to a Subcontractor or supplier, unless such Work has been performed by others and the Contractor has approved said payment.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.3.4 All Applications for Payment shall be accompanied by lien waivers from the Contractor and applicable Subcontractors. The lien waivers, when taken together, shall equal the sum due and paid under the immediately preceding Application for Payment, and shall be effective through the submittal date of the immediately preceding Application.

§ 9.3.5 All Applications for Payment shall be accompanied by the Contractor's and Subcontractors' certified payrolls as required by the Illinois Prevailing Wage Act, 820 ILCS 130/5.

§ 9.3.6 Submission of properly executed lien waivers and the certified payrolls are conditions precedent to certification of each Application for Payment.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to

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payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made, or if any other condition precedent to payment has not occurred. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 If Contractor disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, Contractor may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in accordance with the Local Government Prompt Payment Act, 50 ILCS 505/1, et seq. and as may be otherwise provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be

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required by law. In the sole discretion of the Owner, if the Contractor fails to furnish evidence as required by this Section, the Owner has the right, but not the obligation, to pay Subcontractors and suppliers directly.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If at any time there is evidence of any liens or claims for which the Owner may become liable, the Owner shall have the right to retain, out of any payment due or thereafter to become due to Contractor or a Subcontractor, an amount sufficient to completely indemnify and defend the Owner from and against such lien or claim, including any reasonable attorneys' fees and litigation expenses that have been or may be incurred by the Owner. Should any such evidence be established after all payments are made, the Contractor or Subcontractor shall repay the Owner all sums which the Owner may be compelled to pay in discharging such lien or claim, including all reasonably attorneys' fees, litigation expenses, and other costs resulting from such lien or claim.

§9.6.9 The Owner shall withhold ten percent (10%) from all progress payments to the Contractor as retention. The Contractor shall request retention with its final Application for Payment as provided in Section 9.10. No interest shall accrue on monies held in retention. Contractor shall ensure that each contract between Contractor and each Subcontractor contains this same provision for the withholding and release of retention.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use without any interference resulting from Contractor's operations or from incomplete work. The Work is not substantially complete until all Project systems included in the Work are operational as designed and scheduled, all required governmental inspections and certifications have been made and obtained, designated instruction of the Owner's personnel in the operation of systems has been completed and documented, and all final finishes required by the Contract Documents have been installed. The Work is not substantially complete until the Contractor has submitted the following items to the Owner or Architect::

.1 All As-Built Documents in conformance with the Contract Documents and the requirements of this Agreement;
.2 All operations and maintenance manuals as required by the Contract Documents;
.3 All manufacturers' warranties as required by the Contract Documents; if such warranties cannot be executed until the Certificate of Substantial Completion is executed, the Contractor shall submit a warranty specimen as a condition of Substantial Completion, and shall submit the fully-executed warranty prior to Final Completion.

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.If in the event Contractor does not complete remaining work within thirty (30) days of Substantial completion, Owner shall give the Contractor written notice of the remaining Work to be completed. If the Contractor fails to complete the remaining work to be completed within five (5) days of receipt of the written notice, the Owner reserves the right to complete the remaining Work in accordance with § 2.4 without further notice to the Contractor. All costs incurred by Owner therein shall be offset against Contractor's final payment.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment, which shall be attached to the Certificate of Substantial Completion (the "Punch List"). Failure to include an item on the Punch List does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's Punch List, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's Punch List, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion with the Punch List attached. The Certificate of Substantial Completion shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the Punch List accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate.

§ 9.8.6 Upon Substantial Completion, the Contractor and Subcontractors hereby assign all vendor and manufacturers' warranties to the Owner, if and to the extent any such warranty identified the Contractor or a Subcontractor, and not the Owner, as the entity to whom the warrantor is obligated.

§ 9.8.7 Liquidated Damages. The parties agree that time is of the essence of this Agreement. If the Contractor fails to achieve final completion of the Work by the Substantial Completion date(s) established in the Contract Documents and/or as established in the approved construction schedules, as may be adjusted by extensions of time contained in fully-executed Change Orders, if any (the "Scheduled Date(s) of Substantial Completion"), the Contractor shall be liable to the Owner for and shall pay the Owner liquidated damages in the amounts listed under Section 0005000 "Supplementary General Conditions", for each and every calendar day between the Scheduled Date(s) of Substantial Completion and the actual date(s) of Substantial Completion, and the Owner may set off and deduct such amounts from payments due, or which may later become due, to the Contractor. The parties stipulate and agree that this provision is fair and reasonable, and the per day rate established in this Section is fair and reasonable, considering the nature of the harm that may be incurred by the Owner as a result of such delay, and the difficulty or impossibility of ascertaining, calculating, and/or proving the actual damages resulting from such delay. The parties stipulate and agree that this Section 9.8.7 is a valid and enforceable liquidated delay damages clause, and is not a penalty.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a Punch List to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably

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withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 All Work depicted on the Contractor's Punch List and thereafter identified in the Architect's inspection shall be completed by Contractor within thirty (30) days of issuance of the Certificate of Substantial Completion. Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate, including retention held pursuant to Section 9.6.9, is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, including those fully-executed warranties required by Section 9.8.1.1 to be furnished prior to final completion, and (6) final releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner, along with the final submittal of certified payroll as provided by Section 5 of the Prevailing Wage Act, 820 ILCS 130/5. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs, reasonable attorneys' fees, and litigation expenses.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, and shall not constitute a waiver of Claims. Otherwise, if the Contractor does not complete remaining work within thirty (30) days after Substantial Completion, Owner may complete the remaining Work and backcharge the Contractor in accordance with Section 2.5. All related costs incurred by Owner shall be deducted from Contractor's final payment, and if the amount of Contractor's final Application for Payment is insufficient to cover such costs, Contractor shall pay such insufficiency to Owner upon demand.

§ 9.10.4 Reserved.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and specifically identified by that payee as unsettled at the time of final Application for Payment.

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ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. Neither the Owner nor the Architect shall be responsible for any safety precautions or programs in connection with the Work.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If any person suffers injury or damage to person or property because of an act or omission of a party, or of others for whose acts such party is legally responsible, the responsible party shall give notice of the injury or damage, whether or not insured, to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or

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polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume. By Change Order, the Contract Time shall be equitably extended.

§ 10.3.3 Reserved.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the procurement, delivery, unloading, loading, stockpiling, storing, preparing, installing, use and/or handling of such materials or substances (collectively, "handling").

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and faultily or negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 Reserved.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor, and the Subcontractors, to the extent applicable as specified below, shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in this Section 11.1 and its subparts and elsewhere in the Contract Documents. To the extent of any conflict between this Section 11.1 and other Contract Documents, the Contractor and Subcontractors shall purchase and maintain the insurance with the higher limits, broader coverage, and better protections for the Owner. The Contractor and Subcontractors shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. Such coverage shall be procured on an occurrence basis. Such coverage shall be procured from insurers with a Best's Key Rating Guide rating of at least A / VIII. The Owner, Architect, and Architect's consultants shall by endorsement be named as additional insureds under the Contractor's and each Subcontractor's commercial general liability policy, automobile liability policy, and excess or umbrella policy, all on a primary and noncontributory basis.

§ 11.1.1.1 Commercial general liability insurance including coverage for contractual liability and completed operations, explosion, collapse and underground hazards, covering personal injury, bodily injury and property damage, in the amount of Two Million Dollars ($2,000,000) per occurrence and Two Million Dollars ($2,000,000) aggregate.

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§ 11.1.1.2 Automobile liability insurance, including hired, rented, and non-owed vehicles, covering personal injury, bodily injury and property damage, with a combined single limit of One Million Dollars ($1,000,000).

§ 11.1.1.3 Umbrella / excess insurance coverage with a limit of at least Five Million Dollars ($5,000,000).

§ 11.1.1.4 Workers' compensation insurance in the amount of the statutory minimum with an employer's liability coverage of at least One Million Dollars ($1,000,000).

§ 11.1.1.5 The Contractor, and Subcontractors as applicable, shall maintain the insurance required by this Section 11.1 without interruption from the date of the Agreement until the date of final payment, and, with respect to their completed operations coverage, until three (3) years after Substantial Completion of Work, or for such other period for maintenance of completed operations coverage as specified in the Contract Documents, whichever is greatest.

§ 11.1.1.6 Prior to commencement of the Work, and again prior to the expiration of any policy, the Contractor and all Subcontractors shall furnish to the Owner and Architect certificates of insurance, policy declarations, all policy endorsements, and if requested by the Owner the policies, all reflecting the insurance required by this Section 11.1. An additional certificate and endorsements evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted by Contractor and all Subcontractors with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the time permitted for expiration. If any aggregate limit is reduced on account of claims paid, Contractor and Subcontractor shall immediately notify the Owner and Architect in writing of the amount of such reduction.

§ 11.1.1.7 Failure of either the Architect or Owner to demand certificates of insurance and/or policies and/or endorsements shall not constitute a waiver of the Contractor's and Subcontractor's responsibilities under this Section 11.1. Nor shall review and/or approval by either the Owner or Architect in any way relieve Contractor or any Subcontractor of its responsibility for furnishing sufficient insurance.

§ 11.1.1.8 Liability of Contractor or Subcontractor is not limited by these insurance requirements or by actual insurance coverage. Nothing related to insurance requirements in the Contract Documents is to be construed as limiting the liability of the Contractor, the liability of any Subcontractor of any tier, or the liability of the Architect, or any of their respective insurance carriers. Owner does not represent that the coverages or limits of insurance specified are sufficient or adequate to protect the Owner, Contractor, Architect, or any Subcontractor's interest or liabilities, but are merely minimums.

§ 11.1.1.9 Each Subcontractor shall comply with all requirements of this Section 11.1, except that the Owner may in writing excuse a Subcontractor from procuring and maintaining an excess / umbrella policy in conformance with Section 11.1.1.3, where deemed appropriate by the Owner, in its sole discretion.

§ 11.1.2 The Contractor as principal shall furnish to the Owner as obligee bonds covering faithful performance of the Contract and payment of obligations arising from the Contract. The payment and performance bonds shall strictly comply with the Public Construction Bond Act, 30 ILCS 550/0.01, *et seq.* (the "Act"), and with all provisions of this Section 11.1.2 and its subparts to the extent not in conflict with the Act. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located. Each such surety shall have a Best's Key Rating Guide rating of at least A / VIII.

§ 11.1.2.1 The payment and performance bonds shall be executed on AIA Document A311 or A312, or on another form acceptable to the Owner, and shall include a penal sum equivalent to or greater than the Contract Sum as defined in Section 9.1.1. If the Project involves a Contractor who is also serving as a construction manager at risk that will take or has taken assignment of trades pursuant to Section 5.1.1, then for purposes of determining the penal sum of the bond, the Contract Sum means the aggregate sum of all bids awarded by the Owner and assigned to the Contractor as provided in Section 5.1.1.

§ 11.1.2.2 All terms and conditions of all Contract Documents, including those that comprise these A201 General Conditions, as amended, shall be deemed incorporated by reference into each bond furnished in connection with this Section 11.1.2. In case of any conflict between any provision of any performance or payment bond and the Contract Documents, the provisions of the Contract Documents shall prevail to the extent of such conflict. Any provision of any bond purporting to create a condition precedent for Owner not otherwise contained in the Contract Documents, or which otherwise purports to abrogate or nullify the Owner's rights or remedies otherwise available in contract, law,

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or equity, is void. If any provision of any bond purports to shorten the period of limitations and/or the period of repose as provided in Section 13-214 of the Code of Civil Procedure, 735 ILCS 5/13-214, or if any provision of any bond purports to shorten any other applicable statute of limitation or repose, such provision of such bond shall be null and void, but all other provisions of such bond shall remain enforceable.

§ 11.1.2.3 No surety shall assert solvency of its principal or its principal's denial of default as a defense to any claim under any bond furnished in accordance with this Section 11.1.2.

§ 11.1.2.4 If any surety shall make any assignment for the benefit of creditors or commit any act of bankruptcy, or is declared bankrupt, or if it shall file a voluntary petition in bankruptcy, or shall in the opinion of the Owner be insolvent, the Contractor shall immediately upon request by the Owner furnish and maintain other bonds satisfactory to the Owner. No further payment shall be due nor shall be made to Contractor until the new surety or sureties shall have met the Owner's qualifications.

§ 11.1.2.5 If at any time the Owner shall become reasonably dissatisfied with any surety, or for any other reason such bonds shall cease to be adequate security for the Owner, Contractor shall, within five (5) days after notice to do so, substitute acceptable bonds in such form and sum and signed by such other surety or sureties as may be reasonably satisfactory to the Owner. No further payment shall be deemed due nor shall be made to Contractor until the new surety or sureties shall have met the Owner's qualifications.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished. The Owner may furnish bonds to any person, at any time, without consent of the Contractor.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right but not the obligation to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Builder's Risk Insurance

§ 11.2.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the Contract Sum, as modified by Change Orders, comprising the total value for the entire Project at the site on a replacement cost basis. Any required deductible shall be paid by the Contractor unless the Contract Documents otherwise provide or the Owner acknowledges its obligation to pay such deductibles in writing and prior to commencement of the Work. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.2.1 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.2.2 Reserved.

§ 11.2.3 Notice of Cancellation or Expiration of Contractor's Required Builder's Risk Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Owner: (1) the Owner, upon receipt of notice from the Contractor, shall have the right but not the obligation to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall notbe adjusted; and (3) the Contractor waives all rights against the Owner, Subcontractors, and Sub-subcontractors to the extent any loss to the Contractor would have been covered by the insurance had it not expired or been cancelled. If the Owner purchases replacement coverage, the cost of the insurance shall be backcharged to the Contractor by an appropriate Change Order. The

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furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide required insurance.

§ 11.3 Reservation of Subrogation

§ 11.3.1 The parties' respective rights of subrogation are reserved.

§ 11.3.2 Reserved.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss.

§11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Contractor as fiduciary and made payable to the Contractor as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Contractor shall pay the Architect and Owner their just shares of insurance proceeds received by the Contractor, and by appropriate agreements the Architect shall make payments to its consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Contractor shall notify the Owner of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Owner shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Owner does not object, the Contractor shall settle the loss and the Owner shall be bound by the settlement and allocation. Upon receipt, the Contractor shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Owner timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Contractor may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Owner's or Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Owner or Architect, be uncovered for the Owner's or Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Owner or Architect has not specifically requested to examine prior to its being covered, the Owner or Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor

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shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor an express written acceptance of such specific condition. The Owner shall give such notice promptly after discovery of the condition. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it and backcharge the Contractor in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall be extended on specific items of Work identified by the Owner as defective, and such extension shall commence upon the performance of corrective Work by the Contractor pursuant to this Section 12.2. Such extension shall expire one year from the date of completion of such corrective Work.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to any obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the Owner may seek to enforce that obligation or any other obligation arising under the Contract Documents.

§ 12.2.6 All other warranties and guarantees required by the Contract Documents shall be provided to the Architect prior to Substantial Completion or Final Completion, as applicable, and are separate obligations from the obligations contained in this Section 12.2.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so by express written notice to the Contractor instead of requiring its removal and correction, in which case the Contract Sum will be reduced by deductive Change Order, as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the State of Illinois without regard for conflict of law principles.

§ 13.1.1 Contractor and each Subcontractor shall comply with the Illinois Human Rights Act, 775 ILCS 5/2-101 *et seq*., and Contractor and each Subcontractor hereby certifies that he / she / it has and will maintain at all times during the term of this agreement a written sexual harassment policy in accordance with 775 ILCS 5/2-105(A)(4).

§ 13.1.2 Contractor and each Subcontractor hereby certifies pursuant to Section 33E-11 of the Illinois Criminal Code that he / she / it is not barred from bidding on, or contracting in connection with, the Project as a result of a conviction for either bid-rigging or bid rotating under Section 33E-3 or 33E-4 of the Criminal Code.

§ 13.1.3 The Contractor and each Subcontractor hereby certifies that he / she / it will provide a drug free workplace in compliance Section 3 of the Drug Free Workplace Act, 30 ILCS 580/3.

§ 13.1.4 At least once per month prior to final completion of the Work, the Contractor and each Subcontractor shall submit to the Owner certified payrolls in accordance with Section 5 of the Illinois Prevailing Wage Act, 820 ILCS 130/5.

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§ 13.1.4 Upon the Owner's request, any employee of the Contractor and any employee of any Subcontractor or other supplier or vendor shall submit state-issued identification documents (e.g. driver's license, state identification card, etc.) or other documents to the Owner and provide the necessary consents so that the Owner may obtain a criminal background check of the employee. No person who fails or refuses to produce such documents may work on the Project at the Project site. Alternatively, the Owner reserves the right to direct the Contractor, at any time during the Project, to immediately obtain criminal background checks of Contractor's or Subcontractor's employees. Such criminal background checks will be performed at Contractor's or Subcontractor's expense and at no additional cost to Owner. If in the Owner's sole discretion objectionable information regarding any employee is discovered in the background check, whether performed by Owner or Contractor, such person shall not be allowed to work on the Project at the Project site. The Owner may request new background checks of any employee at any time.

§ 13.1.5 This Contract is subject to and shall be construed in accordance with all provisions of law applicable to the Work and the Project. All applicable rules of law shall prevail over any conflicting provision contained in any of the Contract Documents.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Contractor shall not assign the Contract in whole or in part without written consent of the Owner.

§ 13.2.2 The Contract Documents and these A201 General Conditions provide the rights and obligations by and between Owner, Architect, and Contractor. There are no other beneficiaries to the Contract.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear, without markup by the Architect or Contractor, costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense and without markup by the Architect or Contractor.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

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§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest only in accordance with the Local Government Prompt Payment Act, 50 ILCS 505/1, *et seq.*

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 90 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 Reserved.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed. However, in no event shall Contractor be entitled to overhead and profit on Work not executed, or costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors or suppliers in accordance with the Contract Documents and/or the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of a material breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

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.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
.2 Accept assignment of subcontracts pursuant to Section 5.4; and
.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, including reasonable attorneys' fees, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner upon demand.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be equitably adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. No adjustment shall be made to the extent

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
.2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;
.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work;
.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders; and
.4 Immediately assign to the Owner any sub-contractual assignments requested by the Owner pursuant to Section 5.4.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed. However, in no event shall Contractor be entitled to overhead and profit on Work not executed, or costs incurred by reason of such termination.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents. This Section 15.1.1 does not create any conditions precedent on any cause of action the Owner may have against the Contractor.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with applicable law.

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§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by the Contractor under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the Contractor first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 If the Owner and Contractor agree with the Initial Decision Maker's decision, the Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision. In the event of such agreement, the Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim, and timely notice is a condition precedent to any recovery or relief by Contractor on such Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given, and such notice is a condition precedent to any recovery or relief by Contractor on such Claim. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Reserved.

§ 15.2 Initial Decision

§ 15.2.0 As used in this Section 15.2 and its subparts, "Claims" refers only to Claims by the Contractor, and does not include Claims by the Owner.

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to arbitration or litigation, as the case may be, of any Claim initiated by Contractor and arising prior to the date final payment is due. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the Contractor may commence litigation without a decision having been rendered, and such litigation shall be subject to the Owner's right to elect arbitration as provided in Section 15.4.1. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise,

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User Notes: (1198150707)

or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall not be binding.

§ 15.2.7 Reserved.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Reserved.

§ 15.4 Arbitration

§ 15.4.1 In the sole and exclusive discretion of the Owner, all claims, disputes and other matters in question between any of the Architect, Owner, Contractor, Surety, Subcontractor or any material supplier arising out of, or relating to, agreements to which two or more of said parties are bound, or the Contract Documents or the breach thereof, shall, in the case of such election by the Owner, be decided by arbitration. If the Owner elects such arbitration, it shall be conducted in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then in effect at the time that the demand is made, as modified herein. In any such arbitration, the arbitrator shall make separate findings as to liability and the amount of damages with respect to each party to the arbitration to the extent any liability or responsibility for damages exists. The Architect, surety, subcontractors and material suppliers who have an interest in the dispute shall be joined as parties to the arbitration. The arbitrator shall have authority to decide all issues between the parties. The foregoing option of the Owner to arbitrate and any other agreement to arbitrate with an additional person or persons, duly consented to by the parties, shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrator shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.1.1 If the Owner elects arbitration, in its sole discretion, notice of the demand for arbitration shall be filed in writing with the other part(ies) to the arbitration and with the American Arbitration Association. Such demand for arbitration shall be made within a reasonable time after the claim, dispute or other matter in question has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such claim, dispute or other matter in question would otherwise be barred by an applicable statute of limitations or repose. Whether such limitations have been met shall be decided by the arbitrator if contested by a party.

§ 15.4.1.2 All parties shall carry on the Work and perform their duties during any arbitration proceedings, and the Owner shall continue to make payments to the extent required by the Contract Documents. However, at the request of any party, contested payments may be placed in an escrow account pending resolution of the dispute.

§ 15.4.1.3 If the Owner elects arbitration, in its sole discretion, in addition to the other rules of the American Arbitration Association applicable to any arbitration hereunder, the following shall apply:

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.1 Promptly after the impaneling of the arbitrator, the arbitrator shall establish a procedure for each party to set forth in writing and to serve upon each other party a detailed statement of its contentions of fact and law, along with appropriate responses thereto;

.2 All parties to the arbitration shall be entitled to reasonable discovery procedures as provided by the Illinois Code of Civil Procedure and Illinois Supreme Court Rules, as supplemented by rules to be established by the arbitrator;

.3 The arbitration shall be commenced and conducted as expeditiously as possible consistent with affording reasonable discovery as provided herein. Similarly, the scope of discovery, and the extent of proceedings hereunder relating to discovery, shall be consistent with the parties' intent that the arbitration be conducted as expeditiously as possible.

§ 15.4.2 In the event of any litigation or arbitration between the parties hereunder, the Contractor shall pay the Owner's reasonable attorneys' fees and court costs to the extent the court or tribunal determines the Owner is the prevailing party.

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EXHIBIT "D"

DRAFT AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

BOND AMOUNT: $ « »

PROJECT:
(Name, location or address, and Project number, if any)

«Blank»
« »
« »

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

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This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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User Notes: (1280866934)

Signed and sealed this « » day of « » , « »

	« »
	(Contractor as Principal) *(Seal)*
	« »
(Witness)	*(Title)*
	« »
	(Surety) *(Seal)*
	« »
(Witness)	*(Title)*

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EXHIBIT "E"

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AIA® Document A312™ – 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Blank»
« »

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: « » None « » See Section 16

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

« »
« »
« »
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ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to

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the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and

.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

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§ 16 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

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Payment Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Blank»
« »

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: « » None « » See Section 18

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

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ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

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User Notes: (1932685177)

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

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User Notes: (1932685177)

§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

DRAFT

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User Notes: (1932685177)

EXHIBIT "F"

AIA® Document G702™ – 1992

Application and Certificate for Payment

TO OWNER:		PROJECT:		APPLICATION NO: 001	Distribution to:
					OWNER:
				PERIOD TO:	ARCHITECT:
				CONTRACT FOR: General Construction	CONTRACTOR:
FROM		VIA		CONTRACT DATE:	FIELD:
CONTRACTOR:		ARCHITECT:		PROJECT NOS: / /	:

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM		$0.00
2. NET CHANGE BY CHANGE ORDERS		$0.00
3. CONTRACT SUM TO DATE (Line 1 ± 2)		$0.00
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)		$0.00
5. RETAINAGE:		
a. 0 % of Completed Work (Column D + E on G703: $0.00)=	$0.00	
b. 0 % of Stored Material (Column F on G703: $0.00)=	$0.00	
Total Retainage (Lines 5a + 5b or Total in Column I of G703)		$0.00
6. TOTAL EARNED LESS RETAINAGE (Line 4 Less Line 5 Total)		$0.00
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT (Line 6 from prior Certificate)		$0.00
8. CURRENT PAYMENT DUE		$0.00
9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6)	$0.00	

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$0.00	$0.00
Total approved this Month	$0.00	$0.00
TOTALS	$0.00	$0.00
NET CHANGES by Change Order		$0.00

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED $0.00

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

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User Notes:

AIA® Document G703™ – 1992

Continuation Sheet

AIA Document, G702™–1992, Application and Certification for Payment, or G736™–2009, Project Application and Project Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:	001
APPLICATION DATE:	
PERIOD TO:	
ARCHITECT'S PROJECT NO:	

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G ÷ C)	BALANCE TO FINISH (C – G)	RETAINAGE (IF VARIABLE RATE)
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00%**	**0.00**	**0.00**

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User Notes:

(947138416)

EXHIBIT "G"

DRAFT

AIA® Document G709™ – 2001

Work Changes Proposal Request

PROJECT *(Name and address)*:
Blank

OWNER *(Name and address)*:

FROM ARCHITECT *(Name and address)*:

TO CONTRACTOR *(Name and address)*:

PROPOSAL REQUEST NUMBER: 001

DATE OF ISSUANCE:

CONTRACT FOR: General Construction

CONTRACT DATE:

ARCHITECT'S PROJECT NUMBER:

OWNER: ☐
ARCHITECT: ☐
CONSULTANT: ☐
CONTRACTOR: ☐
FIELD: ☐
OTHER: ☐

Please submit an itemized proposal for changes in the Contract Sum and Contract Time for proposed modifications to the Contract Documents described herein. Within Zero (0) days, the Contractor must submit this proposal or notify the Architect, in writing, of the date on which proposal submission is anticipated.

THIS IS NOT A CHANGE ORDER, A CONSTRUCTION CHANGE DIRECTIVE OR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.

DESCRIPTION *(Insert a written description of the Work)*:

ATTACHMENTS *(List attached documents that support description)*:

REQUESTED BY THE ARCHITECT:

_____ _____

(Signature) *(Printed name and title)*

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Exhibit "H"

CORDOGAN CLARK
ARCHITECTURE ▪ ENGINEERING ▪ CONSTRUCTION

RFI #	#
Owner's Contract #	#
CCA Project #	#

REQUEST FOR INFORMATION (RFI)

Project: #
Contractor Name: name
Subject: description

Date Contractor Issued: date

Specification Section: #

Drawing Number: #

Submitted By: name
Subcontractor RFI No.: #

Date Submitted by Sub: Date

Date Reply Needed: date

Question(s):

Description

Possible Solution(s):

Description

Answer:

Description

This reply is given with the express understanding that it does not constitute a basis for change in the Contract Sum or Contract Time. If you do not agree, DO NOT PROCEED with this work and immediately notify Cordogan Clark.

Responded By: Name

Firm Name: Name

Reply Date: Date

Statement of Liability Limitation for Electronic Transfer of Design

Date:

To: Name
Company

From: Name
Cordogan, Clark & Associates

Re: East Aurora School District #131 – 2026 HS Mechanical Phase 3
CCA Project No.: 261012

The enclosed computer disk(s) or following electronic transmission of data, information or documents have been provided to Company Name (Receiver) at the request of Name. The information transmitted therein pertains to East Aurora School District #131 – 2026 HS Mechanical Phase 3 Project, Cordogan, Clark & Associates Project #261012. See below for the list of specific files being transmitted.

Use of the above-described information shall be deemed as an agreement and notice to the following:

1. Provided Cordogan, Clark & Associates, Inc. CCA exercises reasonable care in the electronic or disk transmission of data, information or documents to the above indicated receivee, the receivee shall be responsible for and solely bear all damages, losses or expenses it or Cordogan, Clark & Associates, its employees, officers and consultants incur as a result of:
   a. Errors or defects introduced by such transmission
   b. The Receivees' and its independent contractors' or agents' automated conversion or reformatting of the data, information or documents transmitted
   c. Defects or errors in the Receivees' and its independent contractors' or agents' software or hardware utilized to receive, transmit, utilize, format or reproduce data, information or documents
2. Provided Cordogan, Clark & Associates and its consultants have exercised reasonable care in the selection and operation of hardware and software for its computer aided design services, Cordogan, Clark & Associates shall not be responsible or liable for errors, defects, inexactitudes or anomalies in data, information of documents (including drawings and specifications) caused by:
   a. Cordogan, Clark & Associates or its consultants' computer software or hardware defects or errors
   b. Cordogan, Clark & Associates consultants' electronic or disk transmittal of data, information or documents
   c. Cordogan, Clark & Associates reformatting or automated conversion of data, information or documents electronically or disk transmitted from Cordogan, Clark & Associates' consultants to Cordogan, Clark & Associates

   Receivee waives all claims against Cordogan, Clark & Associates, its employees, officers and consultants for damages, losses or expenses it incurs arising from such defects or errors.
3. If as otherwise permitted by this Agreement, the Receivee shall electronically or by disk transmit data, information or documents (including drawings and specifications) to persons other than Cordogan, Clark & Associates, the Receivee shall be responsible for and solely bear all damages, losses or expenses arising from:
   a. errors or defects introduced by such transmission
   b. errors or defects introduced by such persons retransmission, automated conversion, reformatting, or reproduction of such data, information or documents
4. Receivee shall indemnify, defend and hold Cordogan, Clark & Associates and its consultants, together with their respective employees and officers, harmless from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorneys' fees and litigation expenses) resulting or arising from errors of defects in data, information or documents, including drawings and specifications, caused or introduced by the Receivee (or its independent contractors and agents):
   a. Provision or transmission of data, information or documents to Cordogan, Clark & Associates
   b. Re-transmission, automated conversion, reformatting or reproduction of Cordogan, Clark & Associates created data, information or documents
   c. Use of defective, erroneous or incompatible software or hardware.

By: _____

Accepted: _____ Company _____

Title: _____ Date: _____

EXHIBIT "J"

Verify that all of your Illinois Sales Tax Exemption Certificate information is correct

- ✓ **If not,** contact us immediately.
- ✓ ***Do not discard*** **-** your Illinois Sales Tax Exemption Certificate is an important tax document that authorizes you to purchase tangible personal property for use or consumption tax-free.

02/02

OFFICIAL DOCUMENT State of Illinois - Department of Revenue OFFICIAL DOCUMENT

Illinois Sales Tax Exemption Certificate

AURORA EAST UNIT SCHOOL DISTRICT #131

310 SEMINARY AVE
AURORA IL 60505-4768

Sales Tax Exemption Certificate

Issue date:
02/11/2025

Sales Tax Exemption **E99960087**

Expiration date:
03/01/2030

Organization type: **Governmental**

This entity is authorized under the Retailers' Occupation Tax Act to purchase tangible personal property for use or consumption tax-free.

ILLINOIS REVENUE
Director

OFFICIAL DOCUMENT - DO NOT DESTROY

STAX-70 (R-05/16)

P-001228

Project # _____

CONFIRMATION OF PLAN REVIEW RECORDS

☐ 2024 International Building Code Plan Review Records

Plan Reviewer Name	Approval to Proceed Date	A/E or Qualified Plan Reviewer Signature	ISBE ID Number or A/E License Number
Comments: ☐ NOT APPLICABLE _____ (initial)			

☐ 2024 International Electrical Code (Appendix K) Plan Review Records

Plan Reviewer Name	Approval to Proceed Date	A/E or Qualified Plan Reviewer Signature	ISBE ID Number or A/E License Number
Comments: ☐ NOT APPLICABLE _____ (initial)			

☐ 2024 International Energy Conservation Code Plan Review Records

Plan Reviewer Name	Approval to Proceed Date	A/E or Qualified Plan Reviewer Signature	ISBE ID Number or A/E License Number
Comments: ☐ NOT APPLICABLE _____ (initial)			

☐ 2024 International Fire Code Plan Review Records

Plan Reviewer Name	Approval to Proceed Date	A/E or Qualified Plan Reviewer Signature	ISBE ID Number or A/E License Number
Comments: ☐ NOT APPLICABLE _____ (initial)			

☐ 2024 International Mechanical and Fuel Gas Code Plan Review Records

Plan Reviewer Name	Approval to Proceed Date	A/E or Qualified Plan Reviewer Signature	ISBE ID Number or A/E License Number
Comments: ☐ NOT APPLICABLE _____ (initial)			

CORDOGAN CLARK
ARCHITECTURE · ENGINEERING · CONSTRUCTION

MILESTONE SCHEDULE

East Aurora School District #131
East Aurora High School Mechanical Improvements Phase III - 2027 Project

October 1, 2026	Bid Documents Available
October 5, 2026 10:00AM CST	Mandatory Pre-Bid Meeting (virtual)
October 6, 2026 @ 7:30am October 9, 2026 @ 9:30am October 12, 2026 @ 11:00am	Facilities Walkthroughs Contact Luca Muench lmuench@cordoganclark.com
October 19, 2026 10:00AM CST	Last Day for Bidder Questions
October 22, 2026 10:00AM CST	Bids Due to District Office
October 23-28, 2026	Post-Bid Interviews
November 2, 2026	Presentation to Building and Grounds
November 16, 2026	Presentation to the Board of Education for Approval
November 17, 2026	Notice to Proceed
November 18, 2026	Building is accessible to mechanical contractor for equipment verification (Nov. 25-27 – No Students in school) (Dec. 21-Jan. 1 – No Students in school)
January 8, 2027	Mechanical contractor to submit results of field verification for CO-OP equipment configuration to CO-OP
January 15, 2027	All other Mechanical submittals and all Plumbing submittals Due to CCA by bidding contractor

February 2, 2027	Mechanical contractor shall provide verification all contractor purchased equipment has been ordered and delivery dates
February 19, 2027	A full and complete construction schedule for all work shall be submitted to CCA.
March 12, 2027	Final date for remaining submittal submissions Due to CCA by bidding contractor
March 29 – April 2, 2027	Spring Break – Spring Abatement (If required) Schedule to be confirmed at later date
April 15-30, 2027	Abatement in Boiler Room – refer to exhibit Schedule to be confirmed at later date
May 28, 2027	Assumed Last Day of 2026-2027 School Year. Footnote #2
May 31, 2027	Contractor Access (Coordination w/ Abatement and District furniture move out will Be Required)
May 31, 2027	Anticipated Final CO-OP Equipment Delivery
June 7-10, 2027	Remaining Abatement – refer to exhibit Schedule to be confirmed at later date
June 21- July 2, 2027 During the hours of 7am to 3pm only	Contractor Access to Server Room 111 & 111A
July 23, 2027	Equipment Startup with air movement, cooling and ventilation in all occupied spaces (1 week before Substantial Completion) Footnote #3
July 30, 2027	Substantial Completion (Exclusive of final balancing and controls) This includes ROE Occupancy Approval. Footnote #4
August 2, 2027	Commissioning Kickoff meeting

August 4, 2027	District Move-in Access
August 27, 2027	Completion of equipment balancing, complete and final reports with all deficiencies corrected for each school submitted to CCA
August 31, 2027	Controls completion, commencement of system commissioning, Contractor to coordinate and schedule with Trane Chicago and commissioning agent when the system is ready for commissioning
November 1, 2027	Completion of Cooling System Commissioning. Includes correcting all deficiencies.
December 16, 2027	Completion of Heating System Commissioning. Includes correcting all deficiencies
December 17, 2027	Final Completion

Footnotes:

1. Significant dates are in bold
2. Contingent upon remaining emergency days. Maximum of 5.
3. Contractor shall provide a full water quality test report for each building within 1 week of equipment startup to the owner and Architect.
4. If an act of God occurs affecting the arrival of equipment and or materials, the General contractor shall provide an updated schedule immediately showing the sequences affected. The project schedule should not extend further then the time of the delay. All items not affected by this act are expected to move forward per the original schedule and potentially be moved ahead of schedule, when possible, to help offset any delays.

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
AURORA, ILLINOIS 60506
630-896-4678

SECTION 024119 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.
3. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at **Project Site**.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted. All utility interruptions must be coordinated with owner’s scheduled use of facility.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

    a. Window Air Conditioners that are to be salvaged

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered other than as noted.

1. Existing windows testing positive for asbestos containing materials to be removed/ replaced per the project requirements shall be abated by the General trades contractor.
2. Hazardous materials will be removed by Owner before start of the Work.
3. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. LED Existing Warranties: All LED lighting in the areas depicted in Blue in (Warranty - Exhibit N) are to be considered under manufacturer's warranty.

1. Any fixtures that are located adjacent to the areas that require the installation of pipe chases, ventilation ducting and/or bulk-heads, will be relocated by another vendor to accommodate the new construction by Contractor.
2. In the event Contractor causes damage to the existing lighting fixtures or any of the adjacent areas during the demolition or new construction, Contractor shall bear the entire cost of correcting all damage resulting from neglect, mishaps, damage (intentional or unintentional) or non-conformance with contract documents. Retain this article if existing warranties are affected. Obtain existing warranties from Owner. Coordinate requirements for existing roofing warranties.

B. All Other Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.

C. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. **Engage a professional engineer to perform** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of **preconstruction photographs or video**.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed or Relocated: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.

3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    c. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    d. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

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:

1. Proceed with selective 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.
2. 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. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. 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.
5. Maintain fire watch during and for at least two (2) hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. **Comply with requirements in Section 017419 "Construction Waste Management and Disposal."**

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

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SECTION 028319- LEAD-BASED PAINT ABATEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. These environmental requirements apply to all projects. These specifications apply for all demolition, construction and renovation projects that require removal and disposal of lead-based paint in accordance with all applicable regulations.

B. The Illinois Department of Public Health regulations apply to all facilities occupied by children 6 years old or younger. Abatement of all interior and exterior lead-bearing substances is covered by these specifications.

1.02 DEFINITIONS

A. In addition to the terms listed below, all definitions in the laws and regulations specified elsewhere in this Section are incorporated by reference, whether or not restated herein.

B. Abatement Contractor (AC): the entity responsible for performing the Work in this Section, with the training and accreditation to competently perform the work. This entity shall obtain and maintain any licenses required for the Work in this Section.

C. Architect of Record (AOR): any person or firm employed by the Board for the purpose of designing the project.

D. Board: the Owner of the property and the authority ordering the Work specified herein.

E. Board Representative: the entity responsible for overall project coordination and completion.

F. Contractor: the entity responsible for performing the complete scope of work in the Documents. The Contractor may elect to self-perform or subcontract out any portion of the work.

G. Competent person: one who is capable of identifying existing lead hazards in the workplace and selecting the appropriate control strategy for lead exposure, who has the authority to take prompt corrective measures to eliminate them, who is specially trained in a training course which meets the criteria of EPA's Model Accreditation Plan for supervisor, or its equivalent.

H. Drawings: drawings and sketches identified in the Contract or incorporated by a bulletin issued by the Architect or Change Order as the Work progresses

I. Environmental Project Manager (EPM): the person selected by the Environmental Consultant to perform environmental monitoring and act on behalf of the Board on the project.

J. HEPA Filter: a High Efficiency Particulate Air filter capable of trapping 99.97% percent of particles greater than 0.3 micrometers in mass median aerodynamic equivalent diameter.

K. IDPH: the Illinois Department of Public Health.

L. Lead Abatement Contractor/Supervisor (supervisor): any person who supervises lead abatement workers. This person must be trained, accredited, and licensed as required, and must also meet OSHA "competent person" criteria for lead abatement.

M. Lead-Based Paint: paints or coatings that are lead bearing substances as defined by IDPH regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications.

N. Lead Bearing Soil: soil containing an amount of lead in excess of applicable guidelines.

O. Lead Bearing Substance: any dust on surfaces or furniture or other non-permanent items and any paint or other surface coating material as defined by IDPH regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications.

P. Managing Environmental Consultant (MEC): the entity with overall responsibility for the environmental aspects of the project, including design, organization, direction, oversight and control as well as investigations, assessments, and supervision of project manager.

Q. OSHA: the federal Occupational Health and Safety Administration.

R. Plasticize: to apply plastic sheeting over surfaces or objects to protect them from contamination or water damage.

S. RCRA: the Resource Conservation and Recovery Act and associated regulations as referenced in Laws, Regulations and Standards specified elsewhere in the specifications.

T. SDS: Safety Data Sheets, required by OSHA for any chemical in the workplace that that could be expected to cause an exposure to workers during normal use or in emergency situations.

U. TCLP: the Toxicity Characteristic Leaching Procedure as specified in EPA 530/SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods 3rd edition, November 1986

V. User or User Agency: means the entity for which or on whose behalf the Board has undertaken to cause the Work to be performed.

W. Wet Cleaning: cleaning all surfaces with a phosphate-free lead dissolving detergent.

X. Work: the obligations of the Contractor under the Contract Documents. Work includes, unless specifically excepted by the Contract Documents, the furnishing of all materials, labor, equipment, supplies, plant, tools, scaffolding, transportation, superintendence, permits, inspections, occupancy approvals, insurance, taxes, and all other services, facilities and expenses necessary for the full performance and completion of the requirements of the Contract Documents. Work also means that which is furnished, produced, constructed, or built pursuant to the Contract Documents.

Y. Work Area: areas where lead abatement activities are conducted.

Z. Work Site: the room or rooms undergoing lead abatement activities. All closets/book rooms/coat hanger rooms/vestibules/washrooms within a room are considered part of the Work Site in which abatement work has been identified on the Drawings, whether or not they are numbered separately.

1.03 SCOPE OF WORK

A. The work includes all labor, equipment, materials, and supplies necessary to perform the Scope of Work in the bid documents by the procedures described herein. The contractor, by submitting a bid for the work, represents itself as knowledgeable and expert in the performance of the work, and includes all things usually and customarily necessary to provide a complete and finished job, whether specifically mentioned or not.

B. Clean-up of lead-bearing dust, flakes, and residues; abatement of paint, architectural components, substrates, or other lead-bearing items listed in the Bid documents including pre-cleaning, moving of furnishings, establishing regulated areas, isolating the Work Areas, protection of adjacent surfaces, containment when required, cleanup and decontamination to the specified clearance levels, proper packaging and disposal of wastes, and all other steps necessary to complete the scope of work.

C. Repair or replacement of damaged surfaces, fixtures, or furnishings to restore them to their pre-existing condition to the satisfaction of the School Representative and school engineer.

D. Compliance with all applicable laws, regulations, standards, and these specifications. In the case of a conflict, the contractor shall comply with the most stringent.

E. All licenses, accreditations, permits, notifications, reports, or other documents required by law, regulation, this specification, or the Bid documents.

1.04 LAWS, REGULATIONS, AND STANDARDS

A. East Aurora School District contractors shall maintain compliance with all applicable current laws, regulations, and standards including, but not limited to those listed below which are incorporated by reference:
   1. 410 ILCS 45: Illinois Lead Poisoning Prevention Act
   2. 77IAC845: Illinois Lead Poisoning Prevention Code (Revision 2/8/2019)
   3. 29 CFR 1910: US OSHA General Industry Standards
   4. 29 CFR 1926: US OSHA Construction Standards
   5. HUD Guidelines: Lead Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing, except Chapter Seven (1995); Chapter 7 of the Guidelines, Lead Based Paint Inspection (Revised, 1997)
   6. 40 CFR Part 61: US EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP)
   7. 40 CFR Part 261: Identification and Listing of Hazardous Waste (Resource Conservation and Recovery Act, RCRA)
   8. 40 CFR 245: Lead Renovation, Repair and Painting.

B. Regulatory changes shall be incorporated into this specification on their effective date. Contractors shall reflect these changes into ongoing projects without any additional notice or cost to the Board.

1.05 ASSESSMENT, MONITORING, TESTING, AND ANALYSIS

A. The MEC will perform inspection, testing, and monitoring services during the work and upon its completion:
   1. Testing of coatings, soils, dust, and debris to determine the presence of lead or other hazardous substances.
   2. Area air monitoring during the work to determine the airborne concentrations of lead inside and outside of the Work Area. The EPM shall stop the Work if airborne lead concentrations outside the Work Area exceed the OSHA Action Level of 30 micrograms per cubic meter of air (µg/m3) as an 8-hour time-weighted average. The Work may re-start when the source of lead release has been identified and resolved, and corrective measures have been instituted to prevent recurrence.

B. Credentials required for analysis of lead:
   1. Accreditation by AIHA or AALA; or
   2. Participation in the Environmental Lead Proficiency Analytical Testing (ELPAT) program or Environmental Lead Laboratory Accreditation Program (ELLAP); or
   3. Participation in the Proficiency in Analytical Testing (PAT) for metals analysis.

1.06 SUBMITTALS

A. The Abatement Contractor (AC) shall submit the following information to the EPM:
   1. Written notification to Illinois Department of Public Health.
   2. Evidence that all contractor employees in the Work Areas are licensed, trained and accredited in accordance with OSHA, NESHAP, and EPA MAP requirements:
      a. Current refresher training certificate.
      b. Current IDPH lead license
      c. Current physician's written opinion
      d. Current respirator fit test data.
   3. Copy of OSHA Exposure Assessment, if available.
   4. OSHA compliance air monitoring records generated during the project.
   5. Waste Shipment Records.
   6. Worker license and certification log.
   7. Safety Data Sheets (SDS) for chemicals used on site.
   8. Work Plan and Schedule.
   9. Laboratory or analyst credentials and proficiency certificates for contractor samples.

B. Prior to beginning Work, the AC shall submit required notifications to applicable regulatory agencies and receive an Owners Authorization and Notice to Occupants from the Board for buildings where lead abatement will take place. The AC shall provide copies of all regulatory notices to the Board Representative, the MEC, and the EPM within 24 hours of sending such notices to the regulatory authority. The AC shall not begin a project until such notices are provided to the Board Representative.

1.07 RECORDKEEPING

A. AC shall retain records for 6 years:
   1. Name and address of the contractor who performed the project.
   2. Location of the project.
   3. Summary of abatement techniques used.
   4. Location of the disposal site for lead-based substances removed from the Work site.

5. Starting and completion dates of the lead abatement project.

PART 2 - PRODUCTS

2.01 TOOLS AND EQUIPMENT

A. All equipment shall at least conform to minimum industry standards.

B. Equipment:
1. Negative Air Machines shall provide HEPA filtration and conform to ANSI Z9.2 fabrication criteria.
2. The AC should ensure that respirators are NIOSH approved for use with lead, asbestos, or other contaminants anticipated in the Work.
3. Contractor is fully responsible for complying with OSHA rules for other Safety equipment, such as hard hats, safety harnesses, eye protection, gloves, footwear, and any other safety devices used on the site.

C. Tools:
1. Shovels and scoops shall be suitable for use in a plasticized containment. Plastic or rubber models are preferred, but metal shovels are acceptable when used with care to prevent damage to poly sheeting and permanent surfaces. Appropriate tape may be applied to the leading edges to aid in poly damage prevention.
2. Scrapers, wire and bristle brushes, utility knives and other hand tools shall be of good quality and suitable for the intended uses. The contractor shall keep an ample supply on hand for the completion of the Work.
3. Power tools such as, but not limited to saws, pneumatic chisels, brushes, sanders, and needle guns shall be equipped with shrouds and HEPA-filtered local exhaust systems to capture released particles.

2.02 MATERIALS

A. Installed materials which become a part of the Work such as, but not limited to, primers, paints, surfacing compounds, and other surface coverings or finishes shall be new unless specified otherwise, of good quality, non-lead-bearing, and shall conform to the respective reinstallation specification sections.

B. Abatement materials:
1. Poly sheeting for all applications shall be 6 mil nominal thickness for all applications.
2. Tape shall be 2” or 3” tape suitable for joining poly seams and attaching poly sheeting to surfaces.
3. Spray adhesives shall be non-flammable and free of methylene chloride solvents.
4. Chemicals used for LBP removal and cleanup shall be free of methylene chloride solvents. The chemicals shall be low-odor and free of volatile compounds.
5. Disposal bags shall be 6 mil where used for single-bagging, and minimum 4 mil where used for double-bagging.
6. Disposable suits, hoods, and foot coverings shall be TYVEK or similar.
7. Solvents shall be compatible with any primers, paints, coatings, or other surfacing materials to be installed following their use.
8. Cleaning solutions shall cause lead to chelate, precipitate, or otherwise effectively release lead from surfaces. Cleaning solutions shall not leave residue on surfaces to be painted.

PART 3 - EXECUTION

3.01 EMPLOYEE TRAINING, QUALIFICATION AND MEDICAL SCREENING

A. Supervisors and workers shall be trained, accredited, and licensed in accordance with IDPH rules.
   1. Contractor shall keep current, up-to-date copies of licenses at the job site at all times.
   2. A licensed supervisor (competent person) shall be present at the Work site at all times when Work under this Section is being conducted.

B. Medical Screening shall be instituted for contractor's employees in accordance with regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications. Medical certificates shall be current.

3.02 PERMISSIBLE LIMITS

A. Permissible Limits of lead in lead bearing substances. Substances with lead content below the following levels are not regulated and are not subject to the requirements of this Section:
   1. 5,000 parts per million (ppm), or 0.5% lead by weight in any substance. However, note that OSHA regulations apply to any operation that releases lead into the air in concentrations in excess of the action level of 30 µg/m3 (see Permissible Exposure Limits for contractor employees below), and the CDPH shall require remedial action when dust contains greater than 10 µg/sf (see sub-paragraph below) of surface area. Actions such as sandblasting, dry sanding, or other dry aggressive abrasive disturbances can generate lead concentrations greater than either of these limits on substances with lower lead contents and, in such instances, shall be required to adhere to this specification, regardless of substance lead content.
   2. 400 micrograms per gram (µg/g) of soil in high contact play areas.
   3. 400 micrograms per gram (µg/g) of soil in other areas.
   4. 10 micrograms per square foot (µg/sf) of surface area of dust on interior floors.
   5. 100 micrograms per square foot (µg/sf) of surface area of dust on other surfaces.

B. Permissible Exposure Limits for contractor employees:
   1. No person shall be exposed to a lead concentration in excess the regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications.
   2. Where exposures exceed regulated levels, medical monitoring shall be instituted by the AC in accordance with the regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications.

3.03 EXPOSURE ASSESSMENT AND MONITORING

A. The AC shall make an assessment of the exposures expected by the tasks to be used for the scope of work listed in the Bid documents. Assessment may be based upon:
   1. Initial monitoring of representative workers who the contractor believes are exposed to the greatest airborne concentrations of lead, or
   2. Past monitoring (within the past 12 months) or objective data for conditions closely resembling the processes, type of material, control methods, Work practices and environmental conditions to be used for this document, or
   3. In the absence of an exposure assessment or monitoring, the contractor shall assume the following exposure conditions:

a. = 400 µg/m3 for manual demolition of lead-bearing substances (i.e., drywall, other architectural components), manual scraping, manual sanding, heat gun use, and power tool cleaning with dust collection systems, or any other task where there is reason to believe an employee may be exposed to airborne lead.
b. = 2,500 µg/m3 for lead burning, rivet busting, power tool cleaning without dust collection systems, cleanup of dry spent abrasives, or movement or removal of abrasive blasting enclosures.
c. > 2,500 µg/m3 for abrasive blasting, welding, cutting, and torch burning.

B. The contractor shall perform personal monitoring in accordance with the regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications.

C. The contractor may be required to perform air monitoring outside the Work Area if there is observance of contamination escape from the Work Area (such as dust accumulation), or evidence of failure of control methods to contain the release of airborne lead particles.

3.04 RESPIRATORY PROTECTION

A. Respiratory protection shall be worn in accordance with all applicable regulations referenced in Laws, Regulations and Standards specified elsewhere in the specifications.

3.05 HYGIENE PRACTICES

A. Eating, drinking, smoking, and applying of cosmetics are not allowed in the Work site or area.

B. A changing area and shower shall be provided for changing into and removing personal protective clothing and for showering or washing before leaving the Work Area. Any person leaving the Work site or Work Area shall rinse his or her mouth with potable water and wash hands and face thoroughly before eating drinking, or smoking. A portable lavatory facility, potable water supply, or portable decontamination unit shall be provided by the contractor for the washing of face and hands before any abatement activities are started. School lavatory facilities shall not be used.

C. Equipment decontamination procedures shall be employed to prevent the spread of lead contamination. Disposable items shall not be reused and shall be disposed of properly.

D. Personal Protection Equipment (PPE) shall include:
1. Full body suits with hoods and shoe covers. Tyvek or similar disposable suits may be worn only once, and must be disposed in accordance with the Waste Disposal Article in the specifications.
2. Appropriate PPE shall be used as required by regulations referenced in Laws, Regulations and Standards specified elsewhere in this Section and established industry practice.

3.06 PROHIBITED ACTIVITIES

A. The following methods shall not be permitted:
1. open flame burning
2. dry-sanding
3. uncontained hydro-blasting or sandblasting
4. use of methylene chloride

5. dry-scraping

3.07 WORK AREA ISOLATION AND PREPARATION

A. General Preparation
   1. Post caution signs at all entrances and exits to the Work Area in accordance with OSHA rules:
      a. at least 20" x 14"
      b. date and location of the lead abatement project
      c. Wording at least 2" high stating, "Caution, Lead Hazard, Do Not Remain in Work Area Unless Authorized"
   2. Secure the Work Area from entry by children, pregnant women, school staff or other unauthorized persons.
   3. Close off the Work Site from other portions of the building by closing doors tightly, taping shut when necessary, or with 6 mil poly z-flap curtains over doorways or entrances to the Work Site.
   4. At Work Area exit, provide walk-off pan, wet towel, or other means to prevent tracking lead contamination to other parts of the facility. A protective liner that is watertight shall be placed under the walk-off pan, wet towel, to prevent damage to the underlying surface.

B. Interior Preparation
   1. Furniture, personal items, and other moveable objects in the Work Site shall be protected with 6 mil poly sheeting and sealed with tape, or moved from the Work Site and stored in a location designated by the MEC. Items shall be cleaned before being moved to another area to prevent cross-contamination.
   2. Turn off all forced air ventilation and seal exhaust and intake points in the Work Site.
   3. Turn off electrical circuits in the Work Area to isolate them from contact. Provide temporary power equipped with Ground-Fault Circuit Interrupter (GFCI) devices to prevent electric hazards in the wet working environments. Power cords must be in good condition, not spliced, not more than 100 feet long, and shall be suspended off the floor and out of workers' way to protect the cords from damage. Cords must not be fastened with staples, hung from nails, or suspended with wire.
   4. Seal the opening seams of all food storage units, such as cabinets or refrigerators, or cover with poly sheeting taped securely in place.
   5. Cover all objects that cannot be moved, such as radiators, stoves, cabinets, built-in furniture, bookcases, or other stationary items with 6 mil plastic sheeting taped securely in place.
   6. If required by the scope of work, remove all carpeting from the Work Site. Lightly mist with water prior to removal to prevent lead dust exposure. Carpeting shall be professionally cleaned or replaced, if required by scope of work.
   7. Cover and protect floors in the Work Site with 6 mil plastic sheeting, sealed with tape. Additional protection may be required to protect flooring materials from potential damages resulting from the /abatement processes. All additional protection shall be provided as needed to ensure that all building surfaces will be adequately protected during the /abatement processes and be included in the base bid.
   8. Establish a negative pressure system to prevent contaminated air from escaping from the Work Site to uncontaminated areas, and consisting of:
      a. Negative air machines (NAMs) exhausted from the Work Site, and vented to the outside of the building whenever possible.
      b. Provide sufficient number of NAMs to provide a negative pressure of 0.02" wc between the Work Area and adjacent spaces, and 4 air changes per hour. Assume

NAMs operate at 80% of design capacity. At least one backup NAM shall be available per Work Site.

c. The negative air system shall remain in continuous operation until cleanup and clearance is achieved.

C. Exterior Preparation

1. 6 mil plastic sheeting shall be placed over the ground, foundation, or other surfaces adjacent to or below the abatement area.
2. Close or otherwise seal windows, grilles, intakes, or other nearby openings (above, below, or beside) that could be exposed to airborne dust from the work.
3. Sheeting shall extend out from the foundation 3 feet per story to be abated, with a minimum of 5 feet and a maximum of 20 feet. This sheeting shall remain in place until completion of final cleaning.
4. Sheeting shall be secured at the foundation and along all edges and seams.
5. When liquid waste is produced by any abatement method used, the edges of the plastic sheeting shall be raised a sufficient distance to contain the liquid waste.

3.08 LEAD ABATEMENT

A. General:

1. Unless otherwise specified in the Bid documents, lead-bearing substances listed in the Bid documents shall be removed by methods that minimize the generation of dust or debris.
2. Lead-based paint abatement practices shall be compatible with and shall produce surfaces that are in conformance with Division 09.
3. Where existing lead-bearing substances may be disturbed by the installation of new work, they shall be removed sufficiently to prevent such disturbances.
4. Following any window dismantlement activity in the Work Area, the abatement contractor shall wet scrape the loose paint off the exposed window lintel and prepare, seal, prime and paint the lintel surface. If the lintel is to be replaced as required by the architect, the abatement contractor shall only remove all the loose paint and not repaint the lintel surface.
5. Where disturbances of lead-bearing substances produce dust, the dust must be assumed to contain lead until tested and proven otherwise. Dust suppression methods, such as misting with water and HEPA vacuums shall be used.
6. Movement of lead-bearing wastes through unsecured school areas:
   a. Wastes shall be contained in 6 mil impermeable (i.e. poly) bags.
   b. Architectural components and other debris shall be wrapped in 6 mil plastic sheeting and sealed with tape.
   c. Load-out only during non-school hours.
   d. Dust and debris shall not be tracked or spilled outside the Work Site. In the event of spillage or tracking, contractor shall HEPA vacuum visible debris and wet wipe all affected areas with a non-TSP lead-dissolving detergent solution.

B. Interior Abatement methods may include:

1. Removal and replacement of the component or surface.
2. Wet scraping of lead-bearing material.
3. Heat gun with operating temperatures not to exceed 700° F.
4. Nonflammable chemical strippers shall not contain methylene chloride. This method is generally used with unique, irreplaceable, architecturally, or historically significant

components. Chemical strippers shall be compatible with new paints, coverings, or coatings to be installed.

5. Sander, needle gun, chipper, scarifier, or other mechanical paint removal system. All such power tools shall be equipped with a HEPA vacuum collection system.
6. Enclosure with a durable material or coating that does not readily tear or peel, such as but not limited to, gypsum board; fiberglass mats; canvas-backed vinyl wall coverings; high pressure, laminated plastic sheet, such as Formica®, tile, vinyl flooring, paneling, plastic, metal, or wood. Enclosures shall only be used when specified in the Bid documents.

C. Exterior abatement methods may include:
1. All methods listed under Interior Abatement.
2. Vacuum-blasting.
3. Contained hydro-blasting or sandblasting.
4. When vacuum-blasting or contained hydro-blasting is used, window interiors shall be sealed with 6 mil plastic sheeting and secured with waterproof tape. All seals shall be checked every two (2) hours to assure integrity. Leaks shall be repaired immediately.
5. Window replacement:
   a. The room interior shall be sealed off and protected from dust entry. If windows are removed from the inside, the room must be fully protected in accordance with Work Area Isolation and Preparation "Interior Preparation" and "Exterior Preparation" specified elsewhere in Part 3. When windows are removed from the outside, protection must be in accordance Work Area Isolation and Preparation "Exterior Preparation" specified elsewhere in Part 3, including at least a seal over the wall immediately inside the window Work Area. In either case, the AC is responsible for preventing lead dust contamination of interior spaces.
   b. Damaged lead-based paint must be removed from the wood window frame parts that will remain, both on the inside and on the outside. MEC will direct the AC whether to abate or mitigate undamaged lead-based paint from wood window frames or frame parts on a case by case basis.
   c. Metal window replacements: The contractor is cautioned that high concentrations of lead dust and asbestos containing caulk have been found behind the window frame caps installed over the original lead-based painted frames during previous window replacements. Although a lead license is not required for non-LBP metal window removal, contractor must assume that he or she may encounter concentrated lead dust. When removing these caps, the room interior shall be protected in accordance with Work Area Isolation and Preparation "Interior Preparation" specified elsewhere in Part 3.
   d.

D. Soil Removal or Remediation:
1. Identify and eliminate the source of lead contamination if possible, to prevent re-contamination of remediated soil.
2. Dust generation shall be held to a minimum and dust suppression methods shall be performed, such as misting with water during handling.
3. Monitoring of airborne dust shall be performed by the MEC and shall not exceed acceptable levels.
4. Soil that is stockpiled prior to disposal shall be:
   a. placed on a layer of impermeable plastic;
   b. kept moist to avoid dust generation; and
   c. covered with impermeable plastic which is secured to the ground.
5. Soil shall be subjected to a TCLP test to determine waste classification.

6. Contaminated soil shall be transported to disposal facility in sealed containers or covered vehicles. Care shall be taken to prevent tracking of contaminated soil off-site by vehicular or foot traffic.

E. Demolition. Structural demolition of buildings does not require removal of lead-bearing substances or lead-licensed contractors or workers. However, the following minimum requirements must be observed to prevent spread of lead contamination:
1. Close windows and seal doors of adjacent or nearby structures. Cover air intakes or other openings on facing walls or roof areas where dust could enter.
2. Mist the demolition activities with water to suppress dust release.
3. Remove and dispose of loose lead-based paint from substrate prior to demolition. Conduct waste characterization for proper disposal.
4. Remove and dispose of loose lead-based paint form floors and horizontal surfaces. Conduct waste characterization for proper disposal.
5. Do not spread debris outside the immediate demolition area.
6. Do not allow foot or other traffic through the demolition area that may spread lead-bearing dust to other building areas.
7. Pulverized painted components may generate lead dust that may require TCLP testing and waste characterization prior to disposal.

3.09 CLEANING AND DECONTAMINATION

A. Interior Cleaning: includes any furniture, cabinets, or other item that was located in the Work Area during the lead-based paint /abatement activities.
1. Properly containerize and remove all lead wastes from the Work Site.
2. HEPA vacuum all surfaces including woodwork, walls, windows, window wells, and floors.
3. Wet clean all surfaces with a cleaning solution.
4. Allow all surfaces to dry and HEPA vacuum any remaining visible residue.

B. Exterior Cleaning:
1. Recover all visible debris from exterior areas.
2. HEPA vacuum surfaces that have been abated, paying particular attention to horizontal surfaces, such as window sills, wells, mullions, ledges, etc., both in the abated area and on nearby windows and surfaces.

3.10 FINAL CLEARANCE

A. A lead abatement Work Area shall be complete if lead dust levels on horizontal interior surfaces, sampled by the EPM, are below:
a. 10 micrograms per square foot (µg/sf) on floors and;
b. 100 micrograms per square foot (µg/sf) on other surfaces.

B. At least 3 wipe samples per contained Work Area shall be collected from floors, window sills, countertops, tops of cabinets, or other representative surfaces. At least one sample shall be collected from the entrance to each work area.

C. The contractor shall restore the Work Area to usable condition including reconnection of electrical, water and HVAC services, removal of barriers and contractor equipment, waste removal and disposal and returning furniture removed as required by Work Area Isolation and Preparation specified elsewhere in Part 3.

3.11 WASTE DISPOSAL

A. All plaster, paint chips, lead dust, cleaning supplies, HEPA filters, vacuum contents and filters, disposable suits, and other concentrated lead-bearing waste shall be packed in at least two 6 mil plastic bags.
   1. Dispose of concentrated lead wastes separately from architectural components.
   2. Subject concentrated wastes to TCLP test to determine waste classification.
   3. Prepare a Waste Shipment Record, to be signed by the generator, shipper, and disposal site; to be returned to the generator within 45 days. IEPA and USEPA Generator I.D. numbers shall be provided by the Board.

B. Architectural components, other items to which lead-based paint remains adhered and cleaned plastic sheeting may be disposed of as common construction and demolition debris. Components shall be wrapped in 6 mil plastic sheeting and sealed with tape. Components shall be transported after school hours if carried through the building.

C. All lead-bearing wastes shall be stored in covered, locked containers until transported off-site.

D. Remove lead waste from the Work Site in accordance with RCRA and special waste disposal requirements.

E. Transport all non-hazardous wastes in covered vehicles to an IEPA-approved landfill.

F. Transport all hazardous wastes in covered vehicles to a hazardous waste landfill permitted to accept lead wastes.

G. Wastes from the site shall not be mixed with wastes from other sites.

END OF SECTION 028319

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SECTION 028320 – SMALL SCALE DISTURBANCE OF PAINTED SURFACES ASSUMED TO CONTAIN LEAD

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. These environmental requirements apply to all Board projects. These specifications apply for all demolition, construction and renovation projects that require the minor disturbance of any painted surface that is assumed to contain lead in accordance with all applicable regulations.

B. Lead Safe Work Practices are required to maintain a healthful learning environment for students, maintain good public relations with neighbors and employees, prevent damage, minimize cleaning and maintenance costs, and to comply with regulations and laws. All contractors (including subcontractors, lower-tier subcontractors, and suppliers) who perform work or provide services at Board facilities are required to utilize Lead Safe Work Practices during their operations and/or activities and be certified in accordance with 40 CFR 745: Lead Renovation, Repair and Painting Program.

C. This Section applies to any disturbances of painted surfaces assumed to contain lead as defined in this section. Disturbances of any quantity of paint known to be Lead Based Paint is not covered by this section.

1.2 DEFINITIONS

A. In addition to the terms listed below, all definitions in the laws and regulations specified elsewhere in this Section are incorporated by reference, whether or not restated herein.

B. Architect of Record (AOR): the entity that assembles the overall documents and bid package, and approves the completed work.

C. Board: the Owner of the property and the authority ordering the Work specified herein.

D. Board Representative: the entity responsible for overall project coordination and completion.

E. Certified Renovator: an individual that is certified by the United States Environmental Protection Agency’s (USEPA) Renovation, Repair and Painting program (40 CFR 745).

F. KCHD: the Kane County Health Department.

G. Contractor: the entity responsible for performing the complete scope of work in the Documents. The Contractor may elect to self-perform or subcontract out any portion of the work.

H. HEPA Filter: a High Efficiency Particulate Air filter capable of trapping 99.97% percent of particles greater than 0.3 micrometers in mass median aerodynamic equivalent diameter.

I. IDPH: the Illinois Department of Public Health.

J. Managing Environmental Consultant (MEC): the entity with overall responsibility for the environmental aspects of the project, including design, organization, direction, oversight and control as well as investigations, assessments, and supervision of project manager.

K. SDS: Safety Data Sheets, required by OSHA for any chemical in the workplace that that could be expected to cause an exposure to workers during normal use or in emergency situations.

L. Plasticize: to apply plastic sheeting over surfaces or objects to protect them from contamination or water damage.

M. Personal Protective Equipment (PPE): the protective suits, head and foot covers, gloves, respirators and other items used to protect persons from potential hazards.

N. Work Area: the area or areas where work is being conducted.

1.3 SCOPE OF WORK

A. Refer to Section 02 24 01 - Environmental Scope Sheets

B. The work includes all labor, equipment, materials, and supplies necessary to perform the Scope of Work in the Documents by the procedures described herein. The Contractor, by submitting a bid for the work, represents itself as knowledgeable and expert in the performance of the work, and includes all things usually and customarily necessary to provide a complete and finished job, whether specifically mentioned or not.

C. Repair or replacement of damaged surfaces, fixtures, or furnishings to restore them to their pre-existing condition to the satisfaction of the Board's Representative, MEC and school engineer.

D. Compliance with all applicable laws, regulations, standards, and these specifications. In the case of a conflict, the Contractor shall comply with the most stringent.

E. All licenses, accreditations, permits, notifications, reports, or other documents required by law, regulation, this specification, or the Documents.

F. No visible emissions or unreasonable odors shall be permitted outside the work area.

G. All products to be used at Board facilities that could potentially emit dusts, fumes, vapors or odors, etc. shall be submitted to the Board's Representative with accompanying SDS for approval prior to the use of the product.

1.4 LAWS, REGULATIONS, AND STANDARDS.

A. The Contractor is responsible for compliance with all applicable federal, state, county and municipal laws, regulations and ordinances including, but not limited to, those listed below, which are incorporated by reference.

B. The following laws, regulations and standards are incorporated by reference:
   1. 29 CFR 1910: US OSHA General Industry Standards.
   2. 29 CFR 1926: US OSHA Construction Standards.
   3. 40 CFR Part 61: USEPA National Emissions Standards for Hazardous Air Pollutants (NESHAP).
   4. 40 CFR 745: Lead Renovation, Repair and Painting Program.
   5. 77 Ill. Adm.Code 845: Lead Poisoning Prevention Code (IDPH), revised February 2019
   6. 11-4-2170: Chicago Building Code- Demolition and renovation safeguards.
   7. 11-4-2190: Chicago Building Code: Sandblasting, grinding and chemical washing of buildings, facilities or other structures - Dust minimization--Containment, wetting or vacuuming; plan required.

C. Contractor shall follow procedures outlined in this specification for all work which requires the disturbance of painted surfaces assumed to contain lead. If contract work requires disturbance of any amount of known lead based paint, Contractor shall perform work in accordance with Specification Section 02 83 19.

PART 2 - PRODUCTS

2.1 TOOLS AND EQUIPMENT

A. All equipment shall at least conform to minimum industry standards.

B. Equipment:
   1. Negative Air Machines shall provide HEPA filtration and conform to ANSI Z9.2 fabrication criteria.
   2. The Contractor should ensure that respirators are NIOSH approved for use with lead, asbestos, or other contaminants anticipated in the work.
   3. Contractor is fully responsible for complying with OSHA rules for other Safety equipment, such as hard hats, safety harnesses, eye protection, gloves, footwear, and any other safety devices used on the site.
   4. Tools:
      a. Shovels and scoops shall be suitable for use in a plasticized containment. Plastic or rubber models are preferred, but metal shovels are acceptable when used with care to prevent damage to poly sheeting and permanent surfaces. Appropriate tape may be applied to the leading edges to aid in poly damage prevention.
      b. Scrapers, wire and bristle brushes, utility knives and other hand tools shall be of good quality and suitable for the intended uses. The Contractor shall keep an ample supply on hand for the completion of the work.
      c. Power tools such as, but not limited to saws, pneumatic chisels, brushes, sanders, and needle guns shall be equipped with shrouds and HEPA-filtered local exhaust systems to capture released particles.

2.2 MATERIALS

A. Installed materials which become a part of the work such as, but not limited to, primers, paints, surfacing compounds, and other surface coverings or finishes shall be new unless specified otherwise, of good quality, non-lead-bearing, and shall conform to the respective reinstallation specification sections.

B. Abatement materials

1. Fire-retardant poly sheeting for all applications shall be 6 mil nominal thickness for all applications.
2. Tape shall be 2” or 3” tape suitable for joining poly seams and attaching poly sheeting to surfaces.
3. Spray adhesives shall be non-flammable and free of methylene chloride solvents.
4. Chemicals used for LBP removal and cleanup shall be free of methylene chloride solvents. The chemicals shall be low-odor and free of volatile compounds.
5. Disposal bags shall be 6 mil where used for single-bagging, and minimum 4 mil where used for double-bagging.
6. Disposable suits, hoods, and foot coverings shall be TYVEK or similar.
7. Solvents shall be compatible with any primers, paints, coatings, or other surfacing materials to be installed following their use.
8. Cleaning solutions shall cause lead to chelate, precipitate, or otherwise effectively release lead from surfaces. Cleaning solutions shall not leave residue on surfaces to be painted.

PART 3 - EXECUTION

3.1 STANDARDS FOR WORK ACTIVITIES

A. General. Work activities covered by this section must be performed by certified firms using certified renovators as directed in 40 CFR 745.89. The responsibilities of certified firms are set forth in 40 CFR 745.89(d) and the responsibilities of certified renovators are set forth in 40 CFR 745.90(b).

B. Occupant protection. Contractor must post signs clearly defining the work area and warning occupants and other persons not involved in the work activities to remain outside of the work area. To the extent practicable, these signs must be in the primary language of the occupants. These signs must be posted before beginning the work and must remain in place and readable until the work and the post-work clearance wipe sampling has been completed. If warning signs have been posted in accordance with 24 CFR 35.1345(b)(2) or 29 CFR 1926.62(m), additional signs are not required by this section.

C. Containing the work area. Before beginning the work, the Contractor must isolate the work area so that no dust or debris leaves the work area while the work is being performed. In addition, the Contractor must maintain the integrity of the containment by ensuring that any plastic or other impermeable materials are not torn or displaced, and taking any other steps necessary to ensure that no dust or debris leaves the work area while the work is being performed. The Contractor must also ensure that containment is installed in such a manner that it does not interfere with occupant and worker egress in an emergency.

3.2 INTERIOR WORK.

A. Remove all objects from the work area, including furniture, rugs, and window coverings, or cover them with plastic sheeting or other impermeable material with all seams and edges taped or otherwise sealed.

B. Close and cover all ducts opening in the work area with taped-down plastic sheeting or other impermeable material.

C. Close windows and doors in the work area. Doors must be covered with plastic sheeting or other impermeable material. Doors used as an entrance to the work area must be covered with

plastic sheeting or other impermeable material in a manner that allows workers to pass through while confining dust and debris to the work area.

D. Cover the floor surface, including installed carpet, with taped-down plastic sheeting or other impermeable material in the work area 6 feet beyond the perimeter of surfaces being worked on, or a sufficient distance to contain the dust, whichever is greater. Floor containment measures may stop at the edge of the vertical barrier when using a vertical containment system consisting of impermeable barriers that extend from the floor to the ceiling and are tightly sealed at joints with the floor, ceiling and walls.

E. Use precautions to ensure that all personnel, tools, and other items, including the exteriors of containers of waste, are free of dust and debris before leaving the work area.

3.3 EXTERIOR WORK

A. Close all doors and windows within 20 feet of the work. On multi-story buildings, close all doors and windows within 20 feet of the work on the same floor as the work, and close all doors and windows on all floors below that are the same horizontal distance from the work.

B. Ensure that doors within the work area that will be used while the job is being performed are covered with plastic sheeting or other impermeable material in a manner that allows workers to pass through while confining dust and debris to the work area.

C. Cover the ground with plastic sheeting or other disposable impermeable material extending 10 feet beyond the perimeter of surfaces being worked on or a sufficient distance to collect falling paint debris, whichever is greater, unless the property line prevents 10 feet of such ground covering. Ground containment measures may stop at the edge of the vertical barrier when using a vertical containment system.

D. If the work will affect surfaces within 10 feet of the property line, the Contractor must erect vertical containment or equivalent extra precautions in containing the work area to ensure that dust and debris from the work does not contaminate adjacent buildings or migrate to adjacent properties. Vertical containment or equivalent extra precautions in containing the work area may also be necessary in other situations in order to prevent contamination of other buildings, other areas of the property, or adjacent buildings or properties.

3.4 PROHIBITED AND RESTRICTED WORK PRACTICES

A. The work practices listed below are prohibited or restricted as follows:
   1. Open-flame burning or torching of painted surfaces is prohibited.
   2. The use of machines designed to remove paint or other surface coatings through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, is prohibited on painted surfaces unless such machines have shrouds or containment systems and are equipped with a HEPA vacuum attachment to collect dust and debris at the point of generation. Machines must be operated so that no visible dust or release of air occurs outside the shroud or containment system.
   3. Operating a heat gun on painted surfaces is permitted only at temperatures below 1,100 degrees Fahrenheit.

3.5 WASTE HANDLING AND MANAGEMENT PRACTICES

A. Waste from work activities must be contained to prevent releases of dust and debris before the waste is removed from the work area for storage or disposal. If a chute is used to remove waste from the work area, it must be covered.

B. At the conclusion of each work day and at the conclusion of the work, waste that has been collected from work activities must be stored under containment, in an enclosure, or behind a barrier that prevents release of dust and debris out of the work area and prevents access to dust and debris.

C. When the Contractor transports waste from work activities, the Contractor must contain the waste to prevent release of dust and debris.

D. Contractor shall dispose of all wastes in accordance with all applicable regulations.

3.6 CLEANING THE WORK AREA

A. After the work has been completed, the Contractor must clean the work area until no dust, debris or residue remains.
   1. Interior and exterior works. The Contractor must collect all paint chips and debris and, without dispersing any of it, seal this material in a heavy-duty bag.
   2. Remove the protective sheeting. Mist the sheeting before folding it, fold the dirty side inward, and either tape shut to seal or seal in heavy-duty bags. Sheeting used to isolate contaminated rooms from non-contaminated rooms must remain in place until after the cleaning and removal of other sheeting. Dispose of the sheeting as waste.
   3. Additional cleaning for interior works. The Contractor must clean all objects and surfaces in the work area and within 2 feet of the work area in the following manner, cleaning from higher to lower:
      a. Walls. Clean walls starting at the ceiling and working down to the floor by either vacuuming with a HEPA vacuum or wiping with a damp cloth.
      b. Remaining surfaces. Thoroughly vacuum all remaining surfaces and objects in the work area, including furniture and fixtures, with a HEPA vacuum. The HEPA vacuum must be equipped with a beater bar when vacuuming carpets and rugs.
      c. Wipe all remaining surfaces and objects in the work area, except for carpeted or upholstered surfaces, with a damp cloth. Mop uncarpeted floors thoroughly, using a mopping method that keeps the wash water separate from the rinse water, such as the 2-bucket mopping method, or using a wet mopping system.

3.7 STANDARDS FOR POST WORK CLEANING VERIFICATION

A. Interiors: The Contractor must perform a visual inspection to determine whether dust, debris or residue is still present. If dust, debris or residue is present, these conditions must be removed by re-cleaning and another visual inspection must be performed. After a successful visual inspection the Contractor must:
   1. Verify that each windowsill in the work area has been adequately cleaned, using the following procedure.
      a. Wipe the windowsill with a wet disposable cleaning cloth that is damp to the touch. If the cloth matches or is lighter than the cleaning verification card, the windowsill has been adequately cleaned.

b. If the cloth does not match and is darker than the cleaning verification card, re-clean the windowsill as directed in paragraphs (a)(5)(ii)(B) and (a)(5)(ii)(C) of this section, then either use a new cloth or fold the used cloth in such a way that an unused surface is exposed, and wipe the surface again. If the cloth matches or is lighter than the cleaning verification card, that windowsill has passed the cleaning verification.

c. If the cloth does not match and is darker than the cleaning verification card, repeat the procedures in paragraph (c) until cloth matches of is lighter than the cleaning verification card.

d. Verify that all uncarpeted floors and other horizontal surfaces have been adequately cleaned using the following procedure:

1) Wipe uncarpeted floors and other horizontal surfaces within the work area with a wet disposable cleaning cloth. Floors must be wiped using an application device with a long handle and a head to which the cloth is attached. The cloth must remain damp at all times while it is being used to wipe the surface for post-work cleaning verification. If the surface within the work area is greater than 40 square feet, the surface within the work area must be divided into roughly equal sections that are each less than 40 square feet. Wipe each such section separately with a new wet disposable cleaning cloth. If the cloth used to wipe each section of the surface within the work area matches the cleaning verification card, the surface has passed the cleaning verification.

2) If the cloth used to wipe a particular surface section does not match the cleaning verification card, re-clean that section of the surface as directed in paragraphs (a)(5)(ii)(B) and (a)(5)(ii)(C) of this section, then use a new wet disposable cleaning cloth to wipe that section again. If the cloth matches the cleaning verification card, that section of the surface has passed the cleaning verification.

3) If the cloth used to wipe a particular surface section does not match the cleaning verification card after the surface has been re-cleaned, repeat the procedures in paragraph (e) until cloth matches or is lighter than the cleaning verification card.

4) When the work area passes all post cleaning verifications the Contractor shall notify the MEC that the area is ready for clearance wipe sampling. Contractor shall notify MEC at least 24 hours in advance for all clearance wipe inspections.

B. Clearance Wipe Sampling

1. The MEC shall conduct clearance wipe sampling in twenty percent (20%) of the work areas. The number of work areas tested shall be based on the total number of work areas anticipated for the entire project and shall be selected randomly from the areas available for testing.
2. Turnaround times for laboratory results for clearance wipe samples shall be 24 hours. Costs of expedited results shall be borne by the Contractor.
3. A work area shall be complete if lead dust levels on horizontal interior surfaces are below 10 micrograms per square foot (µg/sf) on interior floors and stair treads, 100 micrograms per square foot (µg/sf) on other surfaces and 40 micrograms per square foot (µg/sf) on exterior floors and other horizontal exterior surfaces. 3 wipe samples per contained work area shall be collected from floors, window sills, countertops, tops of cabinets, or other representative surfaces.

4. The contractor shall re-clean and repeat the post cleaning verification procedure in all work areas that fail to meet the clearance criteria. The contractor shall notify the MEC when the re-cleaned areas have passed all post cleaning verifications.
5. The MEC shall re-test only those work areas which have been re-cleaned.
6. The contractor shall restore the work area to usable condition including reconnection of electrical, water and HVAC services, removal of barriers and contractor equipment, waste removal and disposal and returning furniture removed as required as specified elsewhere in Part 3.

C. Exteriors:
1. A certified renovator must perform a visual inspection to determine whether dust, debris or residue is still present on surfaces in and below the work area, including windowsills and the ground. If dust, debris or residue is present, these conditions must be eliminated and another visual inspection must be performed.
2. When all surfaces in the area pass the visual inspection, the Contractor shall notify the MEC that the area is ready for final visual inspection.

D. Activities conducted after post-work clearance wipe sampling.
1. Activities that do not disturb paint, such as applying paint to walls that have already been prepared, are not regulated by this subpart if they are conducted after post-work clearance wipe sampling has been performed.

3.8 CONTAMINATION OF AREAS OUTSIDE OF WORK AREAS

A. In the event that dust or fumes escape from the work area or create dirty conditions or contamination to nearby building spaces or grounds, the Contractor is responsible for all costs associated with the cleaning, testing and/ or repair deemed necessary by the Board's Representative.

END OF SECTION 028320

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SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:
   1. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Qualification Data: For Installer and manufacturer .

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Joint-filler strips.
13. Repair materials.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

G. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

H. Field quality-control reports.

I. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Preinstallation Conference: Conduct conference at Project site .

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
   a. Structural 1, B-B or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as- drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F or C.

B. Normal-Weight Aggregates: ASTM C 33, Class 3Scoarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) for slab on grade and 1 inch (25 mm) for footings and foundation walls nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

4. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

2.6 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches (25 to 57 mm) long.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]

a. 3M; Scotchcast Polyolefin Fibers .
b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
c. FORTA Corporation; FORTA FERRO.
d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
e. Nycon, Inc.; XL.
f. Propex Concrete Systems Corp.; Fibermesh 650.
g. Sika Corporation; Sika Fiber .

2.7 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. 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:

a. BoMetals, Inc.
b. Greenstreak.
c. Paul Murphy Plastics Company.
d. Vinylex Corp.

2. Profile: Flat, dumbbell without center bulb
3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick) ; nontapered.

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Reef Industries Inc.; Griffolyn Type-85.

2.9 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals - Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.

i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.10 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or [ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials:

1. Fly Ash: 25 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, foundations, pile caps, and grade beams: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa)at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50
3. Slump Limit: [3 inches (100 mm)] , plus or minus 1 inch (25 mm).
4. Fly ash content: Maximum 15 percent of cementitious materials by weight.
5. Cement Content: Minimum 520 lb per cubic yard
6. Total Air Content: 3 percent naturally occurring, per ASTM C 173
7. Maximum Aggregate Size: 1 inch
8. Water reducing agent required.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa)at 28 days.
2. Slump Limit: 3 inches (100 mm) plus or minus 1 inch (25 mm).
3. Fly ash content: Maximum 15 percent of cementitious materials by weight.
4. Cement Content: Minimum 470 lb per cubic yard, maximum 517 pounds per cubic yard.
5. Total Air Content: 3 percent naturally occurring, per ASTM C 173

6. Maximum Aggregate Size: 1 ½" inch for slab on grade. Combined aggregate shall be well graded and shall contain sizes up to and including 1 ½.
7. Water reducing agent required.
8. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4.0 lb/cu. yd. (2.4 kg/cu. m) .

C. Suspended Slabs: Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Calculated Equilibrium Unit Weight: 115 lb/cu. ft. (1842 kg/cu. m), plus or minus 3 lb/cu. ft. (48.1 kg/cu. m) as determined by ASTM C 567.
3. Slump Limit: 4 inches (100 mm) plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch (10 mm).
5. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4.0 lb/cu. yd. (2.4 kg/cu. m).

2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.+

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm)for smooth-formed finished surfaces.
2. Class C, 1/2 inch (13 mm)] or rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.
4. Install masonry dowels in concrete structures as indicated.
5. Install precast embed plates in concrete structures per the precast manufacturers embed drawings.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

B. 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 for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth] of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot- weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [one] [six] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory- cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 033000

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SECTION 040120.63 - BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid: Unless noted otherwise, the General Contractor shall provide all labor and materials for the complete installation of work as specified in this section.

1. Section Includes:

a. Repairing brick masonry, including replacing units.
b. Painting steel uncovered during the work.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SEQUENCING AND SCHEDULING

A. Order sand for colored mortar immediately after approval of mockups. Take delivery of and store at Project site enough quantity to complete Project.

B. Work Sequence: Perform brick masonry repair work in the following sequence, which includes work specified in this and other Sections:
   1. Inspect masonry for open mortar joints and point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
   2. Clean masonry.
   3. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
   4. Repair masonry, including replacing existing masonry with new masonry materials.
   5. Rake out mortar from joints to be repointed.
   6. Point mortar and sealant joints.
   7. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

   1. Include plans, elevations, sections, and locations of replacement masonry units on the structure, showing relation of existing and new or relocated units.
   2. Show provisions for expansion joints or other sealant joints.
   3. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
   4. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

   5. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.

      a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
      b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.

C. Samples for Verification: For the following:

   1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For brick masonry repair specialist including field supervisors and workers.

B. Preconstruction Test Reports: For existing masonry units and mortar.

1.8 QUALITY ASSURANCE

A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.

1. Field Supervision: Brick masonry repair specialist firm shall maintain experienced full-time supervisors on Project site during times that brick masonry repair work is in progress.

B. Mockups: Prepare mockups of brick masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

    a. Replacement: Four brick units replaced.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on masonry units as follows:

1. Provide test specimens as indicated and representative of proposed materials and existing construction.
2. Replacement Brick: Test each proposed type of replacement masonry unit according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).
3. Existing Brick: Test each type of existing masonry unit indicated for replacement according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by Architect. Take testing samples from these units.

4. Existing Mortar: Test according to ASTM C 295/C 295M, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

F. Handle masonry units to prevent overstressing, chipping, defacement, and other damage.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:

1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.

C. Hot-Weather Requirements: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.

D. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

A. Face Brick: As required to complete brick masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units.

a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

2. Special Shapes:

a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

3. Tolerances as Fabricated: According to tolerance requirements in ASTM C 216, Type FBX.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; white where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Sand: ASTM C 144.

1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary, to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

D. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Davis Colors.
b. LANXESS Corporation.
c. Solomon Colors, Inc.

E. Water: Potable.

2.4 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

C. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer) or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
1. VOC Limit: Use coating with a VOC content of 400 g/L or less.

D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.5 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
   1. Rebuilding (Setting) Mortar by Property: ASTM C 270, Property Specification, Type O] unless otherwise indicated; with cementitious material limited to portland cement and lime.
   2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors require ed.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

   1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
   2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
   3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

3.2 MASONRY REPAIR, GENERAL

A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

3.3 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

   1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.

   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
   3. Store brick for reuse. Store off ground, on skids, and protected from weather.
   4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
1. Rake out mortar used for laying brick before mortar sets according to Section 040120.64 "Brick Masonry Repointing." Point at same time as repointing of surrounding area.
2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.4 PAINTING STEEL UNCOVERED DURING THE WORK

A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:

1. Surface Preparation: Remove paint, rust, and other contaminants according to paint manufacturer's recommended preparation.
2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 10% of section depth, notify Architect before proceeding.

3.5 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent non masonry surfaces. Use detergent and soft brushes or cloths.

C. Remove masking materials, leaving no residues that could trap dirt.

3.6 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.7 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040120.63

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SECTION 042000 - UNIT MASONRY

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. Concrete masonry units.
2. Clay face brick.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry-joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Steel shelf angles for supporting unit masonry.
4. Cavity wall insulation.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 REFERENCE STANDARDS

A. A.ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

B. B.ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. C.ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

D. D.ASTM C55 - Standard Specification for Concrete Building Brick.

E. E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

F. F. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

G. G.ASTM C476 - Standard Specification for Grout for Masonry.

H. H.ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

I. I. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).

J. J. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

K. K.ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength.

L. L. ASTM C1634 - Standard Specification for Concrete Facing Brick.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

C. Samples for Verification: For each type and color of the following:

1. For each type and color of exposed masonry unit.
2. Weep holes and cavity vents.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

    a. Include data on material properties material test reports substantiating compliance with requirements.
    b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    c. For exposed brick, include test report for efflorescence according to ASTM C 67.
    d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548. (By Construction Manager)

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction. Sample Panels:

D. Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall in sizes approximately 60 inches (1500 mm) long by 48 inches (1200 mm) high by full thickness. Demonstrate construction details per construction documents. Coordinate with other exterior mock up requirements in other sections. Mock up to be approved prior to start of masonry construction.

2. Build mock up panel demonstrating construction detailing at windows. Mock up to be approved prior to start of masonry construction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
2. Where one wythe of multi wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

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.

B. Source Limitations 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 single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 x 8 inches and nominal depths as indicated on the drawings for specific locations.
2. Special Shapes: Provide non-standard blocks configured for corners.
3. Load-Bearing Units: ASTM C90, normal weight.
    a. Hollow block, as indicated.
4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid or powder admixture added to concrete masonry units at the time of manufacture.
    a. Performance of Units with Integral Water Repellent:
        1) Water Permeance: When tested per ASTM E514 and for a minimum of 72 hours.
            a) No water visible on back of wall above flashing at the end of 24 hours.
            b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            c) No more than 25% of wall area above flashing visibly damp at end of test.
        2) Flexural Bond Strength: ASTM C1357; minimum 10% increase.
        3) Compressive Strength: ASTM C1314; maximum 5% decrease.
        4) Drying Shrinkage: ASTM C1148; maximum 5% increase in shrinkage.
    b. Use only in combination with mortar and grout that also has integral water repellent admixture.
    c. Use water repellent admixtures for masonry units, mortar and grout by a single manufacturer.

B. Decorative CMUs: ASTM C90.

1. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
2. Pattern and Texture:
    a. Standard pattern, split-face finish.

3. Colors: As selected by Architect from manufacturer's full range.

4. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.5 MASONRY LINTELS

A. General: Provide the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216, grade SW Type FBX

Field Brick #1	Match existing adjacent brick	Modular

1. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

C. Fabricate units with sharp arris and details accurately reproduced with indicated texture on all exposed surfaces, unless otherwise indicated.

1. Shape as detailed in construction documents
2. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.
3. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
4. Provide drips on projecting elements, unless otherwise indicated.

2.7 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color matching adjacent existing construction.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

G. Aggregate for Grout: ASTM C 404.

H. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.

I. Water: Potable.

2.8 REINFORCEMENT

A. Manufacturers of Joint Reinforcement and Anchors:
1. Blok-Lok Limited: www.blok-lok.com.
2. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com.
3. WIRE-BOND: www.wirebond.com.

B. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

C. Reinforcing Steel: Type specified in Section 032000; size as indicated on drawings; uncoated finish.

D. Single Wythe Joint Reinforcement: Ladder type; ASTM A 82/A 82M steel wire, mill galvanized to ASTM A 641/A 641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

E. Adjustable Multiple Wythe Joint Reinforcement: Ladder type with adjustable ties or tabs spaced at 16 in on center and fabricated with moisture drip; ASTM A 82/A 82M steel wire, hot dip galvanized after fabrication to ASTM A 153/153M, Class B; 0.1875 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
   1. Vertical adjustment: Not less than 2 inches.
   2. Basis of Design: Mighty-Lok Adjustable High Strength Reinforcement by Hohman & Barnard
   3. Length: Provide both 4 ½" and 7 ½" as required for normal and extended cavities per drawings.

F. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized, carbon-steel continuous wire.

2.9 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
   2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

   1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
   2. Where wythes do not align, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
   3. Wire: Fabricate from 3/16-inch- (4.8-mm-) or 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

   1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
   2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.

E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.4 mm) thick by 24 inches (600 mm) long, with ends turned up 2 inches (50 mm) or with cross pins, unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

F. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.
3. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch- (1.3-mm-) thick, steel sheet, galvanized after fabrication.

G. Partition Top anchors: 0.097-inch- (2.5-mm-) thick metal plate with 3/8-inch- (10-mm-) diameter metal rod 6 inches (150 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

H. Adjustable Masonry-Veneer Anchors

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

    a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

    a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, and slotted holes for inserting wire tie.
    b. Fabricate sheet metal anchor sections from 0.067-inch- (2.5-mm-) thick, steel sheet, galvanized after fabrication.
    c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel wire.
    d. Products:

        1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213 or D/A 210 with D/A 700-708.
        2) Heckmann Building Products Inc.; 315-D with 316.
        3) Hohmann & Barnard, Inc.; DW-10HS or DW-10-X.
        4) Wire-Bond; 1004, Type III or RJ-711.

3. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.

    a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, and slotted holes for inserting connector section.

b. Connector Section: Rib-stiffened, sheet metal bent plate; sheet metal clip; or wire tie and rigid extruded vinyl clip designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face.
c. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch (2.5-mm-) thick, steel sheet, galvanized after fabrication.
d. Fabricate wire connector sections from 0.188-inch - (6.4-mm-) diameter, hot-dip galvanized, carbon-steel wire.
e. Products:

1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213S.
2) Hohmann & Barnard, Inc.; DW-10-X-Seismiclip.

2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Division 07 Section "Sheet Metal Flashing and Trim."

1. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
2. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

a. Products: Subject to compliance with requirements, provide one of the following:

1) Advanced Building Products Inc.; Peel-N-Seal.
2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
4) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
5) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
6) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
7) Polyguard Products, Inc.; Polyguard 400.
8) Sandell Manufacturing Co., Inc.; Sando-Seal.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following, unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

a. Products:

1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.

E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch (3.6-mm) steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

1. Products:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

F. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Configuration: Provide one of the following:

a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.
b. Sheets or strips, full depth of cavity and installed to full height of cavity.

2.12 INSULATION

A. Refer to Section 072100.

2.13 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp,

unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive cavity wall insulation and air barriers unless otherwise indicated.

3.6 COMPOSITE MASONRY

A. Bond wythes of composite masonry together as follows:

1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.

B. Bond wythes of composite masonry together using bonding system indicated on Drawings.

C. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:
   1. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together as follows:

   1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
      c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.
   2. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.

E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.8 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

   1. Fasten screw-attached anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   3. Space anchors as indicated, but not more than 16 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than one anchor for each 2 sq. ft. (0.2 sq.

m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

B. Provide not less than 1 ¾ inches of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.9 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 2 inches (50 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.12 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.13 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.
3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under air barrier, lapping at least 4 inches (100 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.

4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
4. Space weep holes formed from wicking material 16 inches (400 mm) o.c.
5. Trim wicking material flush with outside face of wall after mortar has set.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches (600 mm) above top of pea gravel.

G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.14 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

3.16 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.17 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

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SECTION 054000 - COLD-FORMED METAL FRAMING

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. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Floor joist framing.
5. Roof rafter framing.
6. Ceiling joist framing.
7. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Include layout, spacing, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing members and connections indicated to comply with design loads, include analysis data prepared, signed and sealed by a registered structural engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by agency a qualified testing agency.
1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
   1. Allied Studco.
   2. AllSteel Products, Inc.
   3. California Expanded Metal Products Company.
   4. Clark Steel Framing.
   5. Consolidated Fabricators Corp.; Building Products Division.
   6. Craco Metals Manufacturing, LLC.
   7. Custom Stud, Inc.
   8. Dale/Incor.
   9. Design Shapes in Steel.
   10. Dietrich Metal Framing; a Worthington Industries Company.
   11. Formetal Co. Inc. (The).
   12. Innovative Steel Systems.
   13. MarinoWare; a division of Ware Industries.
   14. Quail Run Building Materials, Inc.

15. SCAFCO Corporation.
16. Southeastern Stud & Components, Inc.
17. Steel Construction Systems.
18. Steeler, Inc.
19. Super Stud Building Products, Inc.
20. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads:
      a. Dead Loads: Weights of materials and construction.
      b. Live Loads: As indicated on structural drawings.
      c. Roof Loads: As indicated on structural drawings.
      d. Snow Loads: As indicated on structural drawings.
      e. Wind Loads: As indicated on structural drawings.
      f. Seismic Loads: As indicated on structural drawings.

   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/600 of the wall height.
      b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft..
      c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1 inch.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
   3. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

2.3 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.

2.4 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
   1. Minimum Gage: 43-mils (18 gage) unless noted otherwise on the drawings.
   2. Depth: As indicated on the drawings.
   3. Track Width: As indicated on the drawings.
   4. Stud Width: 1-5/8" minimum unless noted otherwise on the drawings.
   5. Galvanized in accordance with ASTM A653/A653M G90/Z275 coating.

B. Framing Connectors: Factory-made formed steel sheet, ASTM A653/A653M SS Grade 50, with G60/Z180 hot dipped galvanized coating and factory punched holes.
   1. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold Formed Steel Structural Members; minimum 16 gage, 0.06 inch thickness.
   2. 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 as indicated on the drawings.
   3. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   4. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers, knee braces, and girts.
   9. Joist hangers and end closures.
   10. Hole reinforcing plates.
   11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire- resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

E. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

    a. Stud Spacing: 24 inches O.C. maximum.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches as indicated on Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.

3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
1. Stud Spacing: As indicated, 24 inches (406 mm) O.C. maximum.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 24 inches As indicated on Drawings O.C. maximum.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shrinkage-resistant grout.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Shop primer.
6. Galvanized-steel primer.
7. Etching cleaner.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by a registered structural engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's registered structural engineer.

a. Select and complete connections using schematic details indicated and AISC 360

b. Use Allowable Stress Design; data are given at service-load level.

C. Moment Connections: Type FR, fully restrained.

D. Construction: Moment frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1, compressible-washer type with plain finish.

C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.

1. Configuration: Straight.
2. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A36/A36M.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Galvanized-Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned, unless noted otherwise on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, 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 of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M.
5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Pretension anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.4 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Miscellaneous steel trim.
4. Metal bollards.
5. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for ladders and bollards

C. Delegated Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Structural Performance of Aluminum Ladders: Ladders, including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B; 0.0528-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting and Section 099123 "Interior Painting."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

D. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Prime shelf angles with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe

B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick, steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

C. Prime steel bollards with zinc-rich primer

D. Provide reflective plastic sleeve cover for bollards with red banding:
   1. Basis of Design: Global Industrial Reflective Bollard Sleeve, Model# WB670524YR, or equivalent.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

C. Prime plates with zinc-rich primer.

2.11 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Galvanize loose steel lintels located in exterior walls.

2.12 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.13 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

2.14 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099123 "Interior Painting"

C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor shelf angles securely to existing construction with expansion anchors.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

D. Provide blocking supports in exterior walls for mounting of ladders. Coordinate installation of blocking with the exterior metal panel installer.

3.3 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least 4 inches in concrete.

C. Anchor bollards in concrete in formed or core-drilled holes not less than 42 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with shrinkage-resistant grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

D. For bollards located in landscaping or unit pavers: Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

E. Fill bollards solidly with concrete, mounding top surface to shed water.

F. Provide reflective plastic bollard cover.

3.4 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055313 - BAR GRATINGS **[ADDENDUM 01]**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal bar gratings.
2. Grating frames and supports.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.
2. Section 055213 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Clips and anchorage devices for gratings.

B. Shop Drawings:

1. Include plans, sections, and attachment details.
2. Signed and sealed by the qualified professional engineer responsible for their preparation.

C. Delegated Design Submittals: For gratings, including manufacturers' published load tables, analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. **[ADDENDUM 01]** Delegated design scope:
   a. Engineered Shop Drawings & Calculations sealed by a licensed engineer, showing final grating panel layouts, bearing bar orientation, support conditions, and verification that the selected grating meets the specified structural performance criteria.
   b. Design of all mechanical connections between grating panels, clips, fasteners, support angles, and sub framing required.
   c. Design of all required subframing or reinforcement, including support angles, intermediate members, stiffeners, edge banding, and any reinforcement at openings, transitions, or penetrations. (All openings must be coordinated with mechanical shop drawings).
   d. Complete coordinated submittal package, including drawings, calculations, material data, and installation requirements demonstrating compatibility with the provided steel frame, mechanical equipment, and in compliance with project specifications.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

B. Welding certificates.

C. Delegated design engineer qualifications.

1.4 QUALITY ASSURANCE

A. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in Illinois where Project is located and who is experienced in providing engineering services of the type indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design gratings.

B. Structural Performance: Gratings to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Limit deflection of treads, platforms, and framing members to L/360.

2.2 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531and NAAMM MBG 532.

B. Welded Steel Grating: As indicated on drawings.

1. Bearing Bar Spacing: 1-3/16 inches (30 mm) o.c.
2. Bearing Bar Depth: 1-1/2 inches (38 mm)(As required to comply with structural performance requirements).
3. Bearing Bar Thickness: 3/16 inch (4.8 mm (As required to comply with structural performance requirements).
4. Crossbar Spacing: 4 inches (102 mm) o.c.
5. Grating Mark W-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch (38-by-4.8-mm) bearing bars at 1-3/16 inches (30 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
6. Traffic Surface: Serrated
7. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

2.3 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum.
2. Provide stainless steel fasteners for fastening stainless steel.

B. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts, and, where indicated, flat washers; ASTM F593 (ISO 3506-1) for bolts and ASTM F594 (ASTM F836M) for nuts, Alloy Group 1 (A1).

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M), and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being

D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.6 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510/A510M.

D. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205).

E. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

2.7 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
2. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced 15/16 inch (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
3. Furnish threaded bolts with nuts and washers for securing grating to supports.
4. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

G. Do not notch bearing bars at supports to maintain elevation.

2.8 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

E. Field Welding: Comply with AWS recommendations and 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.

3.2 INSTALLATION OF METAL BAR GRATINGS

A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 REPAIR

A. Repair Painting:

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055313

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SECTION 061000 - ROUGH CARPENTRY

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. Framing with dimension lumber.

B. Related Requirements:
1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

C. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping**,** and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-

test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

A. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

B. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

C. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.

2.4 DIMENSION LUMBER FRAMING

A. Maximum Moisture Content: 19 percent.

B. Non-Load-Bearing Interior Partitions: Construction or No. 2.

C. Framing Other Than Non-Load-Bearing Interior Partitions: No. 2 of the following species:

1. Douglas fir-larch; WCLIB or WWPA- where exposed to weather.
2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

D. Framing Other Than Non-Load-Bearing Interior Partitions: Any species and grade indicated with a modulus of elasticity of at least 1,600,000 psi, and an extreme fiber stress in bending of at least 900 psifor 2-inch nominal thickness and 12-inch nominal width for single-member use.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.
2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.6 METAL FRAMING ANCHORS

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings.

D. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

E. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

2.7 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

3.2 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds**,** and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

E. Do not splice structural members between supports, unless otherwise indicated.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.
4. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
5. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's International One- and Two-Family Dwelling Code.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

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. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Plywood backing panels.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association
2. NHLA: National Hardwood Lumber Association
3. NLGA: National Lumber Grades Authority
4. SPIB: The Southern Pine Inspection Bureau
5. WCLIB: West Coast Lumber Inspection Bureau
6. WWPA: Western Wood Products Association

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturer's for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Power-driven fasteners.
3. Post-installed anchors.
4. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical rough carpentry assembly **as shown on Drawings**, including supports, attachments, and accessories.
2. Mockup to show how products specified in this section interface with adjoining products from other sections.
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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood blocking, stripping, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame

front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat all miscellaneous carpentry unless otherwise indicated.

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.

5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 5/8-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
   1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 METAL FRAMING ANCHORS

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. Cleveland Steel Specialty Co
   2. KC Metals Products, Inc.
   3. Phoenix Metal Products, Inc.
   4. Simpson Strong-Tie Co., Inc
   5. USP Structural Connectors

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

   1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

   1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

   1. Use for exterior locations and where indicated.

2.8 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

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SECTION 061600 - SHEATHING

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. Wall sheathing.
2. Roof sheathing.
3. Underlayment.
4. Building paper.
5. Building wrap.
6. Sheathing joint-and-penetration treatment.
7. Flexible flashing at openings in sheathing.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
4. For building wrap, include data on air-/moisture-infiltration protection based on testing according to referenced standards.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated plywood.
2. Foam-plastic sheathing.

3. Building wrap.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat all plywood unless otherwise indicated.

2.4 WALL SHEATHING

A. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 79/C 79M or ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.

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. American Gypsum.
    b. LaFarge North America Inc.
    c. G-P Gypsum Corporation.
    d. National Gypsum Company.
    e. Temple-Inland Forest Products Corporation.
    f. United States Gypsum Co.

3. Type and Thickness: Type X, 5/8 inchthick.
4. Edge and End Configuration: Square.
5. Size: 48 by 96 inchesfor vertical installation.

B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corporation.
2. Type and Thickness: Type X, 5/8 inchthick.
3. Size: 48 by 96 inches for vertical installation.

C. Cellulose Fiber-Reinforced Gypsum Sheathing: ASTM C 1278/C 1278M, gypsum sheathing.

1. Product: Subject to compliance with requirements, provide "Fiberock Sheathing with Aqua-Tough" by United States Gypsum Co.
2. Type and Thickness: Type X, 5/8 inchthick.
3. Size: 48 by 96 inches

D. Fiberboard Wall Sheathing: ASTM C 208, Type IV, Grade 2 (Structural) cellulosic fiberboard sheathing with square edges, 1/2 inchthick.

E. Extruded-Polystyrene-Foam Wall Sheathing: ASTM C 578, Type IV, in manufacturer's standard lengths and widths with tongue-and-groove or shiplap long edges as standard with manufacturer.

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. DiversiFoam Products.
    b. Dow Chemical Company (The).
    c. Owens Corning.
    d. Pactiv, Inc.

3. Thickness: 1 inch, 2 inch and/or as required for assembly.

F. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing: ASTM C 1289, Type I, Class 2, aluminum-foil-faced, glass-fiber-reinforced, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.

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. Apache Products Company.
    b. Dow Chemical Company (The).
    c. Johns Manville; Berkshire Hathaway Inc.
    d. Rmax, Inc.

3. Thickness: 1 inch, 2 inch and/or as required for assembly.

2.5 ROOF SHEATHING

A. Plywood Sheathing: DOC PS 1 sheathing.
1. Span Rating: Not less than **24/0**
2. Nominal Thickness: Not less than **1/2 inch**.

2.6 SUBFLOORING

A. Plywood Subflooring: DOC PS 1 single-floor panels or sheathing.
1. Span Rating: Not less than 24
2. Nominal Thickness: Not less than 1 inch.
3. Edge Detail: Tongue and groove.
4. Surface Finish: Fully sanded face.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For roof parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
   1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
   2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.8 WEATHER-RESISTANT SHEATHING PAPER

A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

B. Building Paper: UBC Standard 14-1, Grade D (water-vapor-permeable, kraft building paper) , except that water resistance shall be not less than 1 hour and water-vapor transmission shall be not less than 75 g/sq. m x 24 h.

C. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:

      a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
      b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap
      c. Ludlow Coated Products;Barricade Building Wrap
      d. Pactiv, Inc.; GreenGuard RainDrop

e. Raven Industries Inc.; Rufco-Wrap.
f. Reemay, Inc.; Typar HouseWrap.

3. Water-Vapor Permeance: Not less than **63**g through 1 sq. m of surface in 24 hours per ASTM E 96, Desiccant Method (Procedure A).
4. Allowable UV Exposure Time: Not less than three months.

D. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing Board: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated, and complying with requirements for elastomeric sealants specified in Division 07 Section "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing Board: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing, and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

C. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board and with a history of successful in-service use.

D. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.10 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with **AST**M D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.

b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing
c. MFM Building Products Corp.; Window Wrap.
d. Polyguard Products, Inc.; Polyguard 300.
e. Protecto Wrap Company; BT-20 XL

C. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."

D. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inchfrom edges and ends of boards.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inchfrom edges and ends of boards.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIBERBOARD SHEATHING INSTALLATION

A. Comply with ASTM C846 and with manufacturer's written instructions.

B. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with surface of sheathing and locate perimeter fasteners at least 3/8 inch from edges and ends.

C. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow 1/8-inch open space between edges and ends of adjacent units. Stagger horizontal joints if any.

D. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

3.6 FOAM-PLASTIC SHEATHING INSTALLATION

A. Comply with manufacturer's written instructions.

B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.

3.7 PARTICLEBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations for type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

3.8 HARDBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

3.9 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

A. General: Cover sheathing with weather-resistant sheathing paper as follows:

1. Cut back barrier 1/2 inchon each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap, unless otherwise indicated.

B. Building Paper: Apply horizontally with a 2-inch overlap and a 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.10 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient quantity of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.
3. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.11 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over weather-resistant building paper at bottom and sides of openings.
4. Lap weather-resistant building paper over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.12 PROTECTION

A. Paper-Surfaced Gypsum Sheathing: Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing paper securely fastened to framing. Apply covering immediately after sheathing is installed.

END OF SECTION 061600

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SECTION 072119 - FOAMED-IN-PLACE 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:

1. Closed-cell spray polyurethane foam insulation, and associated miscellaneous materials.

B. Related Sections

1. Division 04 Section “Unit Masonry” for insulation installed in cavity walls
2. Division 07 “Thermal Insulation" for foam-plastic board insulation along interior of foundation wall and below slab.
3. Division 07 Section(s) “SBS-Modified Bituminous Membrane Roofing” for insulation specified as part of roofing construction.
4. Division 09 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Spray polyurethane foam insulation shall be separated from the interior of the building by an approved thermal barrier of ½-inch minimum thickness gypsum wall board that will limit the average temperature rise of the unexposed surface to not more than 250F after 15 minutes of fire exposure. Where insulation is not separated from the interior, provide an intumescent or other coating with FM 4880, UL 1040 or UL1715 written approval indicating manufacturer of spray polyurethane cellular plastic foam insulation and coating as a part of the test assembly.

1. Refer to Part 3 – Execution; Section 3.4 for schedule of tested assemblies.

2.2 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Corporation; Comfort Foam 178 Spray Applied Polyurethane Foam Insulation.
b. Dow Chemical Company (The); STYROFOAM Spray Polyurethane Foam Insulation.
c. Preferred Solutions, Inc.; Staycell 245-2.0 Spray Applied Polyurethane Foam Insulation.
d. Preferred Solutions, Inc.; Staycell ONE STEP 255 Spray Foam Insulation.

2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2.3 THERMAL BARRIER

A. Thermal Barrier: Intumescent or other coating with FM 4880, UL 1040 or UL1715 written approval indicating manufacturer of spray polyurethane cellular plastic foam insulation and coating as a part of the test assembly.

1. Products: Subject to compliance with requirements, provide one of the following:

a. International Cellulose Corporation; Ure-K Thermal Barrier System to 1¼” thickness.
b. Specialty Products, Inc; FlameSeal-TB coating applied at 18 mils dry thickness.
c. Preferred Solutions, Inc.; Stayflex 2505 Thermal Barrier Coating.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

C. Conduct a field adhesion test at existing materials confirming adhesion compatibility.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

3.4 SCHEDULE – TESTED ASSEMBLIES

ASSEMBLY 1	
Dow Chemical Company (The)	STYROFOAM Spray Polyurethane
International Cellulose Corporation	Ure-K Thermal Barrier System

END OF SECTION 072119

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets and counterflashing.
2. Formed low-slope roof sheet metal fabrications.
3. Hanging gutters and downspouts.
4. Formed equipment support flashing.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

C. Samples: For each exposed product and for each finish specified.

D. Maintenance data.

E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.5 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping. Material selection is typically to be metallic-coated steel sheet unless existing adjacent material is aluminum sheet. Provide materials matching existing to eliminate reactions between dissimilar materials.

B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Exposed Coil-Coated Finishes:

    a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

2. Color: As selected by Architect from manufacturer's full range, typically to match adjacent existing finishes.

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Manufacturer's standard clear acrylic coating on both sides.
2. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: As selected by Architect from manufacturer's full range, typically to match adjacent existing finishes.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
    b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch long, but not exceeding 10-foot long, sections. Furnish with 6-inch wide, joint cover plates. Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.

B. Copings: Fabricate in minimum 96-inch long, but not exceeding 10-foot long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
1. Galvanized Steel: 0.040 inch thick.

C. Counterflashing and Flashing Receivers: Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.

D. Fascia: Fabricate in minimum 96-inch long, but not exceeding 10-foot long, sections. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.

2.5 REGLETS

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.

1. Material: Galvanized Steel, 0.022 inch thick.
2. Finish: With manufacturer's standard color coating.

2.6 HANGING GUTTERS AND DOWNSPOUTS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-

stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

B. Downspouts: Fabricate open-face downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Hanger Style: To match existing.
2. Fabricate from the following materials:

a. Galvanized Steel: 0.022 inchthick.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inchthick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inchdeep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal and concrete decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.

F. Rivets: Rivet joints in uncoated aluminum where indicated and where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inchcenters.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inchcenters.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inchcenters.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inchesand bed with sealant.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Loosely lock straps to front gutter bead and anchor to roof deck.
3. Anchor and loosely lock back edge of gutter to continuous cleat, eave or apron flashing.
4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
2. Provide elbows at base of downspout to direct water away from building.
3. Connect downspouts to underground drainage system indicated.

3.5 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:
   1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
   2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

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SECTION 077200 - ROOF 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. Roof Curbs
2. Equipment supports
3. Roof hatches
4. Pipe supports
5. Preformed flashing sleeves.
6. Roof walkways.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated-Design Submittal: For roof hatches and walkways 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 mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

1. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.

C. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.

D. Wood Nailers: Softwood lumber, fire-treated and complying with AWPA C2; not less than 1-1/2 inches thick.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Underlayment:

1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

G. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

H. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

I. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

J. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adaptable Air Products.
b. AES Industries, Inc.
c. Air Balance; a division of MESTEK, Inc.

d. Conn-Fab Sales, Inc.
e. Curbs Plus, Inc.
f. Custom Solution Roof and Metal Products.
g. Greenheck Fan Corporation.
h. KCC International Inc.
i. Kingspan Light + Air, North America.
j. Lloyd Industries, Inc.
k. LMCurbs.
l. Louvers & Dampers, Inc.; a division of Mestek, Inc.
m. Metallic Products Corp.
n. Milcor, Commercial Products Group of Hart & Cooley, Inc.
o. Pate Company (The).
p. Plenums Incorporated.
q. Roof Curb Systems.
r. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
s. Roof Products, Inc.
t. Thybar Corporation.
u. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Material: Zinc-coated (galvanized) steel sheet, 0.064 inch thick.

1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer, continuous around curb perimeter.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch- thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
12. Security Grille: Provide where indicated.
13. Damper Tray: Provide damper tray or shelf with opening of size indicated.

2.4 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AES Industries, Inc.
b. Curbs Plus, Inc.
c. Custom Solution Roof and Metal Products.
d. Greenheck Fan Corporation.
e. LM Curbs.
f. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
g. Pate Company (The).
h. Roof Products, Inc.
i. Thybar Corporation.
j. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Loads: As indicated in drawings.

D. Material: Zinc-coated (galvanized) steel sheet, thickness determined by equipment weight.

1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range, typically to match adjacent existing finishes.

E. Construction:

1. Insulation: Factory insulated with 1-1/2-inch thick polyisocyanurate board insulation compatible with roof system.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Factory-installed continuous fire-treated wood nailers 3-1/2 incheswide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
6. Fabricate equipment supports to minimum height of 18 inches unless otherwise indicated.

7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.5 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Babcock-Davis**;** BRHEA60X120D1T or comparable product by one of the following:

a. AES Industries, Inc.
b. Bilco Company (The).
c. Bristolite Skylights.
d. Custom Solution Roof and Metal Products.
e. Dur-Red Products.
f. Hi Pro International, Inc.
g. J. L. Industries, Inc.
h. Metallic Products Corp.
i. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
j. Naturalite Skylight Systems; Vistawall Group (The).
k. Nystrom.
l. O'Keeffe's Inc.
m. Pate Company (The).
n. Precision Ladders, LLC.

B. Type and Size: Double-leaf lid, 60 by 120 inches

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: 11 gauge Aluminum.

1. Finish: Mill or powder coat.
2. Color: As selected by Architect from manufacturer's full range, typically to match adjacent existing finishes.

E. Construction:

1. Insulation: 2” Polyisocyanurate board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.

4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.
6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

2.6 PIPE SUPPORTS

A. Pipe Supports: Adjustable-height rubber block supports and galvanized steel carrier assemblies; suitable for quantity of pipe runs and sizes.

1. 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:

    a. Cooper Industries, Dura-Blok

2. Pipe Support Height: 3.5”min. above all roof assemblies
3. Finish: Manufacturer's standard.

2.7 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and metal collar.

1. Manufacturers:
    a. Custom Solution Roof and Metal Products
    b. Menzies Metal Products
    c. Thaler Metal Industries Ltd.

2. Metal: Aluminum sheet, 0.063 inchthick.
3. Diameter: 6 inches
4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

1. Manufacturers:
    a. Custom Solution Roof and Metal Products
    b. Menzies Metal Products
    c. Milcor; Commercial Products Group of Hart & Cooley, Inc
    d. Thaler Metal Industries Ltd.

2. Metal: Aluminum sheet, 0.063 inch thick.
3. Height: 13 inches.

4. Diameter: 4 inches.
5. Finish: Manufacturer's standard.

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, 30” x 30”, approximately 3/8 inch thick and acceptable to roofing system manufacturer.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

D. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.

E. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

F. Roof Walkway Pad Installation:
1. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

G. Seal joints with elastomeric as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09 painting Sections.

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

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SECTION 078413 - PENETRATION FIRESTOPPING

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 through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:

1. Division 07 Section "Fire-Resistive Joint Systems."
2. Division 21 Sections specifying fire-suppression piping penetrations.
3. Division 22 and 23 Sections specifying duct and piping penetrations.
4. Division 26, 27, and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.

3. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft (0.01524cu. m/s x sq. m) at both ambient temperatures and 400 deg F (204 deg C).

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.

2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

    a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

        1) UL in its "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application at the end of Part 3:

1. A/D Fire Protection Systems Inc.
2. Grace, W. R. & Co. - Conn.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. RectorSeal Corporation (The).
8. Specified Technologies Inc.
9. 3M; Fire Protection Products Division.
10. Tremco; Sealant/Weatherproofing Division.
11. USG Corporation.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-

penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant

additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestop Systems with No Penetrating Items:

1. Available UL-Classified Systems: C-AJ-.1001-1999.

C. Firestop Systems for Metallic Pipes, Conduit, or Tubing:

1. Available UL-Classified Systems: C-AJ-.

D. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:

1. Available UL-Classified Systems: C-AJ- 2001-2999.

E. Firestop Systems for Electrical Cables:

1. Available UL-Classified Systems: C-AJ- 3001-3999.

F. Firestop Systems for Cable Trays:

1. Available UL-Classified Systems: C-AJ- 4001-4999.

G. Firestop Systems for Insulated Pipes:

1. Available UL-Classified Systems: C-AJ- 5001-5999.

H. Firestop Systems for Miscellaneous Electrical Penetrants:

1. Available UL-Classified Systems: C-AJ- 6001-6999.

I. Firestop Systems for Miscellaneous Mechanical Penetrants:

1. AvailableUL-Classified Systems: C-AJ- 7001-7999.

    a. Latex sealant.
    b. Mortar.

J. Firestop Systems for Groupings of Penetrants:

1. Available UL-Classified Systems: C-AJ- 8001-8999.

END OF SECTION 078413

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SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
2. Urethane joint sealants.
3. Polysulfide joint sealants.
4. Latex joint sealants.
5. Solvent-release-curing joint sealants.
6. Preformed joint sealants.
7. Acoustical joint sealants.

B. Related Sections:

1. Division 04 Section "Concrete Masonry Units" for masonry control and expansion joint fillers and gaskets.
2. Division 08 Section "Glazing" for glazing sealants.
3. Division 09 Section "Gypsum Board" for sealing perimeter joints.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

E. Qualification Data: For qualified Installer and testing agency.

F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

G. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

I. Field-Adhesion Test Reports: For each sealant application tested.

J. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
3. All joint sealants used in areas of food preparation or food storage shall conform to standards of National Sanitation Foundation, Ann Arbor, Michigan, and shall bear the N.S.F. seal.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Mockups: Build exterior wall mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical joint sealants assembly **as shown on Drawings**, including supports, attachments, and accessories.
2. Mockup to show how products specified in this section interface with adjoining products from other sections.
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.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Omniseal 50.
b. Dow Corning Corporation; 795.
c. GE Advanced Materials - Silicones; SilPruf NB SCS9000, SilPruf SCS2000.
d. May National Associates, Inc.; Bondaflex Sil 295.
e. Pecora Corporation; 864.

f. Polymeric Systems, Inc.; PSI-641.
g. Sika Corporation, Construction Products Division; SikaSil-C995.
h. Tremco Incorporated; Spectrem 2.

B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Omniplus.
b. Dow Corning Corporation; 786 Mildew Resistant.
c. GE Advanced Materials - Silicones; Sanitary SCS1700.
d. May National Associates, Inc.; Bondaflex Sil 100 WF.
e. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Sika Corporation, Construction Products Division; Sikaflex - 15LM.
b. Tremco Incorporated; Dymonic FC.

B. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; Dynatrol II.
b. Polymeric Systems, Inc.; PSI-270.
c. Tremco Incorporated; Dymeric 240 and Dymeric 240 FC.

2.4 POLYSULFIDE JOINT SEALANTS

A. Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, polysulfide joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide products by one of the following:
a. Pecora Corporation
b. BASF Corporation
c. Sika Corporation

2.5 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolac.
b. Bostik, Inc.; Chem-Calk 600.
c. May National Associates, Inc.
d. Pecora Corporation; AC-20+.
e. Schnee-Morehead, Inc.; SM 8200.
f. Tremco Incorporated; Tremflex 834.

2.6 SOLVENT-RELEASE-CURING JOINT SEALANTS

A. Acrylic-Based Joint Sealant: ASTM C 1311.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Schnee-Morehead, Inc.; Acryl-R Acrylic Sealant.
b. Tremco Incorporated; Mono 555.

B. Butyl-Rubber-Based Joint Sealant: ASTM C 1311.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Bostik, Inc.; Chem-Calk 300.
b. Pecora Corporation; BC-158.
c. Tremco Incorporated; Tremco Butyl Sealant.

2.7 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. 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:

a. Hilti, Inc.
b. Pecora Corporation.
c. Tremco Incorporated.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Pecora Corporation.

2.8 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

I. INSTALLATION OF ACOUSTICAL JOINT SEALANTS

1. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
2. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
3. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

2. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

3. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
4. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

TYPE	POLYMER	EXPOSURE/TRAFFIC	USES / APPLICATIONS
SCS	Silicone	Exterior joints in vertical surfaces and non-traffic horizontal surfaces	• Control and expansion joints in cast-in-place concrete. • Control and expansion joints in masonry, metal and composite metal. • Aluminum windows and between windows and other materials. • Aluminum curtain wall, storefront and entrances and between curtain wall, storefront and entrances and other materials • Joints between materials listed above and frames of doors and windows. • Control and expansion joints in soffit and overhead surfaces. • Other joints as indicated.
2 – PUS1	Two-part Urethane	Exterior joints in horizontal traffic surfaces	• Control, expansion, and isolation joints in cast-in-place concrete slabs. • Joints in paving. • Other joints as indicated.
SCS or 2 – PUS1	Silicone or Two-part Urethane.	Interior moving joints in vertical surfaces and horizontal nontraffic surfaces	• Control and expansion joints on exposed interior surfaces of exterior walls. • Perimeter joints of exterior openings where indicated. • Joints between tops of non-fire rated walls and underside of floors and beams. • Tile control and expansion joints • Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions. • Perimeter joints between interior wall surfaces and frames.

TYPE	POLYMER	EXPOSURE/TRAFFIC	USES / APPLICATIONS
MRS	Mildew-Resistant Silicone	Interior wet areas	• Locker rooms • Toilet rooms • Shower areas
2 – PUS2	Two-Part Urethane	Interior horizontal traffic joints	• Paving and flooring control and expansion joints
2 - PPSS	Two-Part Polysulfide	Interior wet areas	• Control and expansion joints in swimming pool and pool deck
ALS	Acrylic Latex Sealants	Interior	• Interior non-moving exposed sealants in gypsum drywall construction

END OF SECTION 079200

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 SUBMITTALS

A. Product Data: For each type of door indicated. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Ampco, Inc.
3. Buell Door Company Inc.
4. Eggers Industries.
5. Graham; an Assa Abloy Group company.
6. Haley Brothers, Inc.
7. Marshfield Door Systems, Inc.
8. Mohawk Flush Doors, Inc.; a Masonite company.
9. Oshkosh Architectural Door Company.
10. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.

B. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
2. Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces and exits.

C. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, made with binder containing no urea-formaldehyde resin.

2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
3. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Comply with specified requirements for exposed edges.

E. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors :

1. Grade: Premium, with Grade A faces
2. Species: Select Red Oak
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Core: Particleboard
8. Construction: Seven plies, either bonded or nonbonded construction.
9. Room Match: Provide door faces of compatible color and grain within each separate room or area of building
10. Exposed Vertical and Top Edges: Same species as faces - edge Type A

2.4 LOUVERS AND LIGHT FRAMES

A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces
2. Profile: Flush rectangular beads
3. At wood-core doors with fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-6 catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.

4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

3.2 Proceed with installation only after unsatisfactory conditions have been corrected

3.3 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

D. Samples for Verification: For each type of exposed finish required.

E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Firedoor Corporation.
7. Fleming Door Products Ltd.; an Assa Abloy Group company.
8. Habersham Metal Products Company.
9. Kewanee Corporation (The).
10. Mesker Door Inc.
11. Pioneer Industries, Inc.
12. Security Metal Products Corp.

13. Steelcraft; an Ingersoll-Rand company.
14. Windsor Republic Doors.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I.

H. Glazing: Division 08 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.3 STANDARD HOLLOW METAL DOORS

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. General: Comply with ANSI/SDI A250.8.
1. Type: As indicated in the Door and Frame Schedule.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

a. Fire Door Core: As required to provide fire-protection ratings indicated.
b. Thermal-Rated (Insulated) Doors: R-value of not less than 12.3 deg F x h x sq. ft./Btu (2.166 K x sq. m/W) when tested according to ASTM C 1363.

3. Vertical Edges for Single-Acting Doors: Square edge.
4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.

5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

C. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless)

a. Width: 1-3/4 inches (44.5 mm)

D. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

a. Width: 1-3/4 inches (44.5 mm)

E. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 4 Steel Doors: 0.067-inch- (1.7-mm-) thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless at concrete and masonry wall locations.
3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
4. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
5. Frames for Wood Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
6. Frames for Borrowed Lights: 0.053-inch- (1.3-mm-) thick steel sheet.

D. Hardware Reinforcement: ANSI/SDI A250.6.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.

2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, same material as door face sheet.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, same material as frames.

D. Terminated Stops: Where indicated, terminate stops 6 inches (152 mm) above finish floor with a [45]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.8 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

2.9 FABRICATION

A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

B. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) high.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Three anchors per jamb up to 60 inches (1524 mm) high.
        2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
        5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.

    c. Compression Type: Not less than two anchors in each jamb.
    d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.

    a. Single-Door Frames: Three door silencers.
    b. Double-Door Frames: Two door silencers.

D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: ANSI/SDI A250.10.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.3 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

D. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Ceiling access doors and frames

B. Related Requirements:
1. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.2 ALLOWANCES

A. Access doors and frames are part of an access door and frame allowance.

1.3 SUBMITTALS

A. All submittals shall be in pdf format.

B. Product Data: For each type of access door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes and fire ratings for access doors and frames.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

D. Samples: For each door face material in specified finish.

E. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain doors and frames through one source from a single manufacturer (if possible).

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 for vertical access doors and frames.
2. ASTM E 119 for horizontal access doors and frames.

C. Size Variations: Obtain Architect’s acceptance of manufacturer’s standard-size units, which may vary slightly from sizes indicated.

1. Coordination
   a. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Steel Sheet: Uncoated cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Factory-Primed Finish: Manufacturer's standard shop primer.

D. Drywall Beads: 0.0299-inch zinc-coated steel sheet to receive joint compound.

2.2 ACCESS DOORS AND FRAMES FOR CEILINGS

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. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
3. J. L. Industries, Inc.
4. Karp Associates, Inc.
5. Larsen's Manufacturing Company.
6. Milcor Inc.
7. Nystrom, Inc.

B. Flush Access Doors and Trimless Frames: Fabricated from steel sheet.

1. Locations: Ceiling surfaces.
2. Door: Minimum 0.060-inch- thick sheet metal.
3. Frame: Minimum 0.060-inch- thick sheet metal with drywall bead flange.
4. Hinges: Continuous piano.
5. Lock: Cylinder.

    a. Lock Preparation: Division 08 Section "Door Hardware."

6. Latch: Self closing bolt operated by flush key with interior release.
7. Finish: Steel

C. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.

1. Locations: Wall and ceiling surfaces.
2. Fire-Resistance Rating: Not less than that of adjacent construction.
3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
5. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- wide, surface-mounted trim.
6. Hinges: Continuous piano.
7. Automatic Closer: Spring type.
8. Lock: Self-latching device with cylinder lock.

    a. Lock Preparation: Division 08 Section "Door Hardware."

9. Latch: Self closing bolt operated by flush key with interior release.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Exposed flanges: Nominal 1 to 1½ inches wide around perimeter of frame.
2. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
3. Provide mounting holes in frames to attach frames to metal framing in drywall construction to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.4 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.5 STEEL FINISHES

A. Surface preparation: prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPS surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Interiors (SSPC Zone 1A): SSPS-SP-3; "Power Tool Cleaning."

B. Apply shop primer to uncoated surfaces of metal fabrications. Comply with SSPS-PA-1, "Paint Application Specification No. 1" for shop primer application. See Division 9 Section "Painting" for field-applied coats.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts and anchoring devices.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Storefront framing for punched openings.

B. .Related sections include the following:
1. Division 8 – Section 088000 “Glazing”.

1.2 PERFORMANCE REQUIREMENTS

A. Provide systems, including anchorage, capable of withstanding loads and thermal and structural movements indicated without failure when supporting full dead loads and without framing members transferring stresses to glazing.

B. Structural-Silicone-Sealant Joints: Less than 20-psi tensile and shear stress in joints.

C. Structural Loads:

1. Wind Load: As designed to application by manufacturer’s structural engineer.

D. Structural Performance: Provide systems, including anchorage, capable of withstanding loads indicated.

1. Deflection Normal to Glazing Plane: Limited to 1/175 of clear span or 3/4 inch, whichever is smaller, unless otherwise indicated.
2. Deflection Parallel to Glazing Plane: When carrying full dead load, not to exceed amount that reduces glazing bite below 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Structural Testing: ASTM E 330 at 150 percent of inward and outward wind-load design pressures for duration required by design wind velocity without system evidencing material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 percent of clear span. Duration shall be as required by design wind velocity; Fastest 1 mile (to 609 km) of wind for relevant exposure category.

F. Air Infiltration: Limited to 0.06 cfm/sq. ft. of system surface area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas.

G. Water Penetration: No water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward acting wind-load design pressure but not less than 6.24 lbf/sq. ft).

H. Temperature Change (Range): Accommodate 120 deg F ambient and 180 deg F material surfaces.

I. Condensation Resistance Factor (CRF): Not less than 45 per AAMA 1503.1.

J. Average Thermal Conductance (U-Value): Not more than 0.63 Btu/sq. ft. x h x deg F per AAMA 1503.1.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

C. Samples: For each type of exposed finish required.

D. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E. Product test reports.

F. Field quality-control reports.

G. Maintenance data.

H. Warranties: Sample of special warranties.

I. Sample panel: provide sample material matching specified system for installation into a masonry mock up panel for demonstration and coordination of construction detailing

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

G. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

a. Failure includes, but is not limited to the following:
1) Structural failures including, but not limited to, excessive deflection.
2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.

3) Failure of operating components to function normally.
4) Water leakage through fixed glazing and frame areas.
5) Noise or vibration created by wind and thermal and structural movements

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Corporation Series 403 Thermally Broken Storefront System or comparable product by one of the following:

1. OldCastle BuildingEnvelope
2. Kawneer North America; an Alcoa company.
3. Tubelite.
4. United States Aluminum.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels, venting windows and accessories, from single manufacturer.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Finish: **(Addendum #2)**
   a. East Aurora High School: Clear Anodized

b. O'Donnell: Anodized Dark or Medium Bronze to match existing.

4. Exterior Glazing Plane: **(Addendum #2)** Center, match existing.
5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system or fabricated from stainless steel.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.5 ALUMINUM FINISHES

A. Finish to be selected from manufacturer’s full range of standard colors and finishes.

2.6 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-), extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile; 5-inch (127-mm) nominal width.

a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.

3. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, 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 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).

c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weather tight closure.

B. Remove excess sealant and glazing compounds, and dirt from surface.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure entrance and store front systems are without damage or deterioration at the time of substantial completion.

END OF SECTION 084113

CORDOGAN, CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware

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"

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 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
2. NFPA 101 – Life Safety Code
3. NFPA 105 – Smoke and Draft Control Door Assemblies
4. 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. 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.

3. 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.

4. 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.

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. If there is a discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy and request direction from Architect for resolution.

B. 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.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

C. 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. 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.

D. 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) 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. Review required testing, inspecting, and certifying procedures.
   d. Review questions or concerns related to proper installation and adjustment of door hardware.

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.

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 L Series: 10 years
        2) Closers
            a) LCN 4000 Series: 30 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 manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Basis of Design” shall be in accordance with substitution procedure in division 01 25 00. In the individual article for the product category, shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products 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 in accordance with substitution procedure in division 01 25 00.

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.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series, no substitute.

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: Heavy weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Heavy 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

2.04 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series, no substitute.

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
   a. Lever Design: 06A.

2.05 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
   a. Match existing.

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.

2.06 KEYING

A. Scheduled System:

1. 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.

B. Requirements:

1. Construction Keying:
   a. 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. 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)
   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.
   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.

2.07 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

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.

2.08 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4040XP series, 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.

2.09 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives, no substitute.

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.

2.10 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives, no substitute.

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.

2.11 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

B. Scheduled Manufacturer:

1. Zero International, no substitute.

C. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.

1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
   a. Provide non-corrosive fasteners for all exterior applications.
   b. Provide security fasteners where indicated.

2. Provide Neoprene, EPDM, Silicone, or Nylon Brush inserts. Provide non brush inserts of solid or sponge cell, as indicated in hardware sets.

D. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for smoke control ratings indicated based on testing according to UL 1784.

E. Fire Listed Gasketing: Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction for fire ratings indicated based on testing according to UL-10C.

1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.

2.12 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. 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.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. 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.

L. 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.

M. Perimeter Gasketing:

1. Apply to head and jamb, forming seal between door and frame.
2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.

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. 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:

Hardware Group No. 01

115G 115H 115I 115J

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP AT OUTSWING LOCKING DOORS)	652	IVE
1	EA	PASSAGE SET	L9010 06A	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	188S-BK PSA (OMIT @ NON-RATED DOORS, USE SILENCERS)	BK	ZER

Hardware Group No. 02

A2-0

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	027XY/112XY HEIGHT AS REQ	628	IVE
1	EA	NARROW STILE DEADBOLT	1603	626	ACC
1	EA	MORTISE CYL TURN	09-900	626	SCH
1	EA	CYLINDER	TYPE AS REQ MATCH EXISTING KEY SYSTEM X CONST. CORE	626	
2	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-226	A	ZER

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. This Section includes the following:
   1. Glass for doors, all-glass entrance systems, and aluminum framed entrance and storefronts.
   2. Glazing sealants and accessories.

1.2 RELATED WORK

A. Section 08 41 13 “Aluminum Framed Entrances and Storefronts.”

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of product specified. 12 inches square.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location.

E. Qualification Data: For installers.

F. Product Certificates: For glass and glazing products, from manufacturer.

G. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cardinal Glass Industries.
2. Guardian Industries Corp.; SunGuard.
3. Pilkington North America.
4. PPG Industries, Inc.
5. Trulite Glass & Aluminum Solutions, LLC.
6. Viracon, Inc.
7. Oldcastle Glass

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain insulated glass for exterior glazing from single source from single manufacturer.
2. Obtain glass for interior glazing from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.3 GLASS AND SILICONE SPANDREL COATING PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, Colors: **clear**, as scheduled

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I, Color: clear

C. Silicone-Coated Spandrel Glass: ASTM C 1036, Type I, Quality-Q3, Class I, Color: clear

D. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Oldcastle Glass
2. Pilkington
3. PPG Industries – Basis of design glass tint : Azuria
4. Opaci-Coat 300 – Basis of design silicone coating spandrel, Colors : To be decided by architect from manufacturer’s full list of standard colors, MINIMUM THICKNESS OF .2MM OR AS RECOMMENDED BY MANUFACTURER

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Spacer: Aluminum with bronze, color anodic finish.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Field-applied sealants shall have a VOC content of not more than 250 g/L.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1. Dow Corning Corporation.
    2. Pecora Corporation.
    3. Sika Corporation.
    4. Tremco Incorporated.

C. Coordinate all sealants used with glazing manufacturer, curtain wall manufacturer, and all-glass entrance system manufacturer requirements.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.10 GLASS TYPES

2.11 INSULATING-GLASS TYPES

A. Glass Type IGU-1: Low-e-coated, insulating glass.
1. Applications: Exterior windows
2. Overall Unit Thickness: 1 inch.
3. Thickness of Each Glass Lite: ¼”
4. Outdoor Lite: low-e solar control glass, match tint of existing windows if applicable.
5. Interspace Content: Air.
6. Indoor Lite: Clear float glass
7. Low-E Coating: On #2 surface
8. Visible Light Transmittance: 40 percent.
9. Winter Nighttime U-Factor: 0.28.
10. Summer Daytime U-Factor: 0.26.
11. Solar Heat Gain Coefficient: 0.21.
12. Shading Coefficient: 0.25.
13. Light to Solar Gain: 1.90
14. Visible Light Reflectance (outside): 7%
15. Total Solar Transmittance: 15%
16. Total Solar Reflectance (outside): 19%
17. Ultraviolet Transmittance: 3%

18. Provide safety glazing labeling.

B. Glass Type IGU-2: Low-e-coated, insulating frosted glass.
1. Applications: Exterior windows in private interior spaces
2. Overall Unit Thickness: 1 inch.
3. Thickness of Each Glass Lite: ¼”
4. Outdoor Lite: low-e solar control glass, match tint of existing windows if applicable.
5. Interspace Content: Air.
6. Indoor Lite: Clear float glass with frosted translucent coating.
7. Low-E Coating: On #2 surface
8. Translucent Coating: On #3 surface
9. Visible Light Transmittance: 40 percent.
10. Winter Nighttime U-Factor: 0.28.
11. Summer Daytime U-Factor: 0.26.
12. Solar Heat Gain Coefficient: 0.21.
13. Shading Coefficient: 0.25.
14. Light to Solar Gain: 1.90
15. Visible Light Reflectance (outside): 7%
16. Total Solar Transmittance: 15%
17. Total Solar Reflectance (outside): 19%
18. Ultraviolet Transmittance: 3%
19. Provide safety glazing labeling.

C. Glass Type SG-1: Silicone-coated, insulating spandrel glass.

1. Applications: Exterior windows above interior ACT Ceilings.
2. Overall Unit Thickness: 1 inch (25 mm)
3. Thickness of Each Glass Lite: ¼”
4. Outdoor Lite: Fully tempered float glass – Color: **Clear**
5. Interspace Content: Air.
6. Indoor Lite: Fully tempered float glass – Color: **Clear**
7. Low-E Coating: On #2 surface
8. Opaque Coating Location: On #4 surface.
9. Opaque Coating Color: **To be decided by architect from full list of manufacturer’s standard colors**
10. Provide safety glazing labeling.
11. Opaque Coating to be completely opaque with no light transmittance.

D. Insulated Panel Type IP-1: Insulated panel infill.

1. Applications: Exterior windows with convectors in front of them.
2. Product Basis of Design: Provide Mapes Architectural Panels Mapes-R Infill Panel, 1” thick with polyisocyanurate core or approved equal.
3. Color: To match storefront framing color.

2.12 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.13 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

2.14 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

2.15 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

2.16 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

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SECTION 089000 - LOUVERS AND VENTS

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 Sections:

1. Division 04 Section "Unit Masonry" for building wall vents (brick vents) into masonry.
2. Division 23 Sections for louvers that are a part of mechanical equipment.
3. Division 23 Section "Instrumentation and Control for HVAC" for electric, electronic, and pneumatic control of adjustable louvers.
4. Division 26 Sections for electrical power connections for motor-operated adjustable 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.

E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

D. 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

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.
3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

C. Samples for Verification: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. 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. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 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. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant 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.

E. 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 per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. 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.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
3. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

G. Provide extended sills for recessed louvers.

H. 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.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Sightproof, Drainable Blade, Wind-Driven Rain Resistant Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Company; EME520DD Wind-Driven Rain Resistant Stationary Louver or comparable product by one of the following:
   a. Air Flow Company, Inc.
   b. Greenheck Corporation.

2. Louver Depth: 5 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.063 inch for blades and 0.081 inch for frames.
4. Louver Performance Ratings:

   a. Free Area: Not less than 6.99 sq. ft for 48-inch- wide by 48-inch- high louver.
   b. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 400 fpm.

5. 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: Insect screening.

B. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels with clips.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected from Manufacturer’s full range of colors.

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.

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 and vents 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 weathertight 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. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be 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.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents 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 and vents 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 089000

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SECTION 090320 - HISTORIC TREATMENT OF PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Repair and replacement of interior gypsum plaster.

1.2 UNIT PRICES

A. Work of this Section may be affected by unit prices specified. Refer to front end specifications and scope sheets for more information.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to historic treatment of plaster and fire protection.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

   1. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches (1200 mm) in least dimension to represent surfaces and

conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:

a. Install 6 linear ft. (2 m)] of wet-applied plaster molding.

PART 2 - PRODUCTS

2.1 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C28/C28M, with mill-mixed perlite aggregate.
2. Gypsum Neat Plaster: ASTM C28/C28M for use with job-mixed aggregates.
3. Gypsum Wood-Fibered Plaster: ASTM C28/C28M.
4. High-Strength Gypsum Neat Plaster: ASTM C28/C28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.
5. Gypsum Gaging Plaster. ASTM C28/C28M.
6. High-Strength Gypsum Gaging Plaster: ASTM C28/C28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C472 for a neat mix.
7. Gypsum Ready-Mixed Finish Plaster: ASTM C28/C28M; manufacturer's standard, mill-mixed, gaged, interior finish.
8. Gypsum Keene's Cement: ASTM C61/C61M.

B. Hydrated Lime: ASTM C206, Type S.

C. Aggregates:

1. Aggregate for Base-Coat Plasters: ASTM C35, sand.
2. Aggregate for Float Finishes: ASTM C35, sand; graded per ASTM C842.

D. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of glass or polypropylene fiber free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

E. Bonding Compound: ASTM C631.

2.2 LATH

A. Metal Lath:

1. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet, ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coated.
   a. Diamond-Mesh Lath: Flat Self-furring, [2.5 lb/sq. yd. (1.4 kg/sq. m)] [3.4 lb/sq. yd. (1.8 kg/sq. m)].

2.3 TRIM ACCESSORIES

A. General: According to ASTM C841 for gypsum plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Cornerite: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
2. Striplath: Fabricated from expanded-metal lath with ASTM A653/A653M, G60 (Z180), hot-dip galvanized zinc coating.
3. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.
   a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
   b. Small nose cornerbead with perforated flanges; use on curved corners.

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:
   1. For Gypsum Plaster: ASTM C841.

C. Wire Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Verify that substrate surface conditions are suitable for repairs.
3. Provide lath, furring, and support systems for plaster included in the work of this Section.
4. Replace lost details in new, wet-applied and cast plaster that replicate existing or indicated plaster configurations.
5. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
6. Install temporary protective measures to protect historic surfaces that shall be treated later.

B. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.

C. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

D. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

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E. Wet masonry and concrete bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

F. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

G. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

H. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.3 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at all locations identified for demolition. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C842 unless otherwise indicated.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Gypsum-Plaster Base Coats:

1. Base Coats over Expanded-Metal Lath: High-strength gypsum neat plaster with job-mixed sand for scratch and brown coats. Add fiber to scratch coat.
2. Base Coats over Expanded-Metal Lath:
    a. Scratch Coat: Gypsum wood-fibered plaster; neat or with job-mixed sand.
    b. Brown Coat: Gypsum neat plaster with job-mixed sand.
3. Base Coats over Unit Masonry: Gypsum neat plaster with job-mixed sand.
4. Base-Coat Mix over Monolithic Concrete: Gypsum neat plaster with job-mixed sand.

D. Gypsum-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finishes: High-strength gypsum gaging plaster.

E. Gypsum-Plaster Finishes: Match finish(es) of mockup sample(s).

1. Provide troweled finish unless otherwise indicated.

3.4 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to [ASTM C1063 for lime plaster] [and] [ASTM C841 for gypsum plaster].

B. Metal Lath: Install according to ASTM C841 for gypsum plaster.

3.5 PATCH-TYPE REPAIR

A. General: Patch openings created for mechanical scope of work as follows:

1. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
2. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
3. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
4. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material.
5. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.

B. Gypsum-Plaster Mix: Gypsum neat plaster with job-mixed sand, applied in two coats with fiber in first coat. Final repair types to be determined in in-field mockups prior to commencement of full scope of repair work.

C. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster. For molded plaster shapes, tool surface to restore the sharp edges and the shape of the molded shape to original contours.

D. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

END OF SECTION 090320

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Grid suspension systems for gypsum board ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.

B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G60, (Z180), hot-dip galvanized in all wet environments.

B. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.

1. Minimum Base-Metal Thickness: As indicated on Drawings and/or as required.
2. Depth: As indicated on Drawings and/or as required.

C. Slip-Type Head Joints: As required, provide the following in thickness not less than indicated for studs and in width to accommodate depth of studs:

1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) MBA Building Supplies; FlatSteel Deflection Track.
3) Steel Network Inc. (The); VertiClip SLD.
4) Superior Metal Trim; Superior Flex Track System (SFT).
5) Telling Industries; Vertical Slip Track.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.018 inch.

E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

2.3 SUSPENSION SYSTEMS

A. Hanger Attachments to Concrete

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or AC193 as appropriate for the substrate.

    a. Uses: Securing hangers to structure.

    b. Type: Torque-controlled, expansion anchor
    c. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: 2-1/2 inches

E. Furring Channels (Furring Members) provide one of the following:

1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.

    a. Minimum Base-Metal Thickness: 0.018 inch
    b. Depth: As indicated on Drawings

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

    a. Minimum Base-Metal Thickness: 0.018 inch.

4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.

    a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong World Industries, Inc.
    b. Chicago Metallic Corporation.
    c. United States Gypsum Company.

2.4 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt or foam gasket.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Do not attach hangers to steel roof deck.
4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered

D. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

E. Gypsum Ceiling Board (Field): ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
   Long Edges: Tapered.

F. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

G. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.

1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
2. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Gypsum.
   b. CertainTeed Corporation.
   c. Continental Building Products, LLC.
   d. Georgia-Pacific Building Products.
   e. National Gypsum Company.
   f. Temple-Inland Building Products by Georgia-Pacific.
   g. United States Gypsum Company.

2. Core: 1/2 inch, regular type.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Core: 5/8 inch, Type X.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: ASTM B 221, Alloy 6063-T5.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

D. 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.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.

F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type: Vertical surfaces, unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Type C: Where required for specific fire-resistance-rated assembly indicated.
4. Flexible Type: Apply in double layer at curved assemblies.
5. Ceiling Type: Ceiling surfaces.
6. High-Impact Type: As indicated in drawing partition types.
7. Moisture- and Mold-Resistant (Toilets, wet rooms, showers, kitchens) Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. Bullnose Bead: Use at outside corners.
3. LC-Bead: Use at exposed panel edges.

4. L-Bead: Use as required.
5. U-Bead: Use at exposed panel edges.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

E. Comply with ASTM C 840.

F. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.6 APPLYING AND FINISHING PANELS

A. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish at Lobby Clouds: Use short nap rollers for paint applications so as not to fill perforations. Filled perforations will compromise the assembly’s acoustic integrity.

E. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile
3. Level 3: Where indicated on Drawings
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

5. Level 5: Where indicated on Drawings

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 095123 - ACOUSTICAL TILE CEILINGS

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. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Initial Selection: For components with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 6-inch- long Sample of each type.
3. Exposed Moldings and Trim: Set of 6-inch- long Samples of each type and color.

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-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components adjacent to acoustical tiles.

B. Qualification Data: For testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in 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. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed acoustical tile ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling tile from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1. Obtain both acoustical ceiling tiles and suspension system from the same manufacturer.

D. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:

1. Surface-burning characteristics of acoustical tiles comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
2. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, 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. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Products: Subject to compliance with requirements, provide products from the following:

a. Armstrong World Industries.
b. CertainTeed (The Celotex Corporation).
c. USG Interiors Inc.

B. Source Limitations:

1. Suspended Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.
2. Directly Attached Acoustical Tile Ceilings: Obtain each type of acoustical ceiling tile from single source from single manufacturer.

3.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

3.3 ACOUSTICAL TILES

A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

B. Field Tile:
1. 2’ x 2’ x 3/4” Lay-in ceiling tile – Reveal Beveled 15/16”, Performa Symphony F, CertainTeed, or equal.

C. Kitchen, Toilet Room and Locker Room Tile:
1. 2’ x 2’ x 3/4” Lay-in ceiling tile – Reveal Beveled 15/16”, Performa Symphony F-RX, Cleanable and NRC 0.95, CertainTeed, or equal.

D. High NRC Sound Absorbing Tile:
1. 2’ x 2’ x 3/4” Lay-in ceiling tile – Reveal Beveled 15/16”, Performa Symphony M High NRC, NRC 0.80, CertainTeed, or equal.

E. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches way from test surface per ASTM E 795.

F. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.
1. Where appearance characteristics of acoustical tiles are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that

comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

G. Antimicrobial Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial solution consisting of a synergistic blend of substituted ammonium salts of alkylated phosphoric acids admixed with free alkylated phosphoric acid that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria.

3.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.

1. High-Humidity Finish: in toilet rooms, locker rooms, shower rooms, kitchens, and high humidity spaces, provide coating tested and classified for "severe environment performance" according to ASTM C635/C635M.

B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation.

3.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Cast-in-place and Postinstalled bonded anchors.
b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
c. Corrosion Protection: Stainless-steel components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

3.6 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
2. Finish: Painted in color as selected from manufacturer's full range.

B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

3.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079200 " Joint Sealants."

PART 4 - EXECUTION

4.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

4.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C636/C636M and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.
2. Install tiles with pattern running in one direction parallel to [**long**] [**short**] axis of space.
3. Install tiles in a basket-weave pattern.

G. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches o.c.
3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

4.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

4.5 ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base (RB)
2. Resilient molding accessories

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard sample size but not less than 12 inches long, of each resilient product color, texture, and pattern required.

C. Maintenance data. Submit manufacturer’s maintenance instructions, including maintenance procedures and materials, procedures for stain removal and surface repair, and recommended schedule for cleaning.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Manufacturer’s Qualification: Obtain materials from a single manufacturer with a minimum of twenty (20) years verifiable experience providing materials of the type specified in this section.

C. Applicator Qualification: Installation must be performed by a manufacturer certified applicator with skilled mechanics having not less than five (5) years satisfactory experience in the installation of the type of system as specified in this section.

D. Pre-Application Meeting: Convene a preapplication meeting before the start of application of coating systems. Require attendance of parties directly affecting work of this section, including Architect, Construction Manager, Contractor, Applicator, and Manufacturer’s Representative. Review the following:
1. Environmental requirements

2. Protection of surfaces not scheduled to be coated
3. Surface preparation
4. Application
5. Repair
6. Field quality control
7. Cleaning
8. Coordination with other work

1.4 PROJECT CONDITIONS

A. The contractor shall visit the jobsite prior to beginning the installation of Resilient Products to evaluate substrate condition, including substrate moisture content, and the extent of repairs required, if any. Concrete substrates shall be tested by a third party to verify that the moisture content of the substrate does not exceed the Resilient Products System manufacturers' recommendations.

B. Substrate Conditions: Use the current test methods described below to determine the dryness as required to ensure initial and long-term success:
1. Comply with ASTM F2170 testing procedures.
2. Comply with ASTM F1869 testing procedures (see #4 below).
3. A third-party testing agent shall conduct in-site relative humidity testing (ASTM F2170) or anhydrous calcium chloride testing (ASTM F1869), whichever is recommended by resilient flooring manufacturer. Perform minimum of 3 tests for the first 1000 square feet and at least one test for each additional 1000 square feet, to ensure concrete internal relative humidity does not exceed 90% or moisture vapor emissions do not exceed 10.0 lb per square feet within a 24 hour period, depending on resilient flooring manufacturer’s recommendations.
4. Only use the ASTM F 1869, anhydrous calcium chloride test of vapor emission if recommended by the flooring manufacturer, otherwise, ASTM F 2170 should be used.

C. The flooring contractor shall verify in writing to the Architect / Construction Manager, a minimum of two (2) weeks prior to scheduled resilient flooring installation, acceptance of the following substrate conditions:
1. Moisture: Maximum of 90% internal relative humidity tested in accordance with the current ASTM F2170 or maximum of 10.0 lb moisture vapor emission rate tested in accordance with the current ASTM F1869.
2. Alkalinity (ASTM F710): Minimum 7.0 pH and Maximum 10.0 pH.
3. Suitability of Substrate Surface: Ensure that substrate surface is sound, smooth and flat to 1/8 inch in 10 feet.
4. Letter of Certification from adhesive manufacturer and moisture remediation sealer manufacturer that both products are compatible with one another.

D. Surface Preparation: Surface must be free of cracks, dirt, oils, paint, curing compounds, or other contaminants which may affect the appearance or performance of the applied material.

E. Environmental Requirements/Conditions: In accordance with manufacturer’s recommendations. Areas to receive flooring shall be clean, fully enclosed, weather tight with stable environmental conditions between 65 degrees F – 81 degrees F, and 50% (± 10%) relative humidity for 48 hours before during and continuously after installation.

F. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products until substantial completion.

G. Install resilient base and resilient molding accessories after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE (RB)

A. Manufacturers: Subject to compliance with requirements, provide products by Mannington Mills, Inc. or one of the following:

1. Mohawk Industries
2. Tandus Centiva, a Tarkett Company

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset)
2. Manufacturing Method: Group I (solid, homogeneous)
3. Style: Cove (base with toe – tiled areas) and Straight (flat or toeless – carpeted areas)

C. Minimum Thickness: 0.080 inch

D. Height: refer to drawings

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Pre-formed/pre-manufactured.

G. Inside Corners: Pre-formed/pre-manufactured.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by Johnsonite or one of the following:

a. Roppe Corporation
b. R.C.A. Rubber Company

B. Components:
1. Carpet bar for tackless installations.

2. Carpet edge for glue-down applications.
3. Nosing for carpet.
4. Nosing for resilient floor covering,
5. Reducer strip for resilient floor covering.
6. Joiner for tile and carpet.
7. Transition strips.

C. Material: Rubber.

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Cove Base Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Metal Edge Strips: Schluter Strips or an approved equal. Extruded aluminum with mill finish of width and of height required to protect exposed edges of tiles. Use in maximum available lengths to minimize running joints.

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting the resilient accessories performance. Examine resilient accessories for type, color, pattern, and potential defects.

B. Flooring contractor is responsible for all surface preparation necessary existing walls and concrete slabs and for installation of resilient products meeting warranty requirements, this includes but is not limited to crack repair, control joint repair, hole filling, leveling. No additional costs will be considered for floor preparation.
1. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
2. Any unforeseen or extreme conditions that require additional floor preparation are to be brought to the Architect / Construction Manager for review.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

D. Concrete Substrates for Resilient molding accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Testing will be performed by a third-party agency. Flooring contractor to coordinate time of testing. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 10 lb of water/1000 sq. ft.in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 90% relative humidity level measurement.

E. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer’s recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

    a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended by the manufacturer.

END OF SECTION 096513

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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile (LVT)
2. Vinyl Composition Tile (VCT)

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

C. Samples: Full-size units of each color and pattern of floor tile required.

D. Maintenance data.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Substrate Conditions: Use the current test methods described below to determine the dryness as required to ensure initial and long-term success:
1.Comply with ASTM F2170 testing procedures.
2.Comply with ASTM F1869 testing procedures (see #4 below).

3. The owner's testing agent shall conduct in-site relative humidity testing (ASTM F2170) or anhydrous calcium chloride testing (ASTM F1869), whichever is recommended by resilient flooring manufacturer. Perform minimum of 3 tests for the first 1000 square feet and at least one test for each additional 1000 square feet, to ensure concrete internal relative humidity does not exceed 85% or moisture vapor emissions do not exceed 10.0 lb per square feet within a 24 hour period, depending on resilient flooring manufacturer's recommendations.
4. **Only use the ASTM F 1869, anhydrous calcium chloride test of vapor emission if recommended by the flooring manufacturer, otherwise, ASTM F 2170 should be used.**
5. Contingency for high moisture readings: if at the time of testing the moisture readings are in excess of 85% internal relative humidity or 10.0 lb moisture vapor emissions, the Architect will direct the owner's testing service to initiate a petrographic analysis to determine the water/cement ratio and if 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.

D. The flooring contractor shall verify in writing to the Owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
1. Moisture: Maximum of 85% internal relative humidity tested in accordance with the current ASTM F2170 or maximum of 10.0 lb moisture vapor emission rate tested in accordance with the current ASTM F1869.
2. Alkalinity (ASTM F710): Minimum 7.0 pH and Maximum 10.0 pH.
3. Suitability of Substrate Surface: Ensure that substrate surface is sound, smooth and flat to 1/8 inch in 10 feet. It is the Flooring Contractor's responsibility to meet this 1/8" in 10 feet requirement.
4. Letter of Certification from adhesive manufacturer and moisture remediation sealer manufacturer that both products are compatible with one another.

E. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations. Areas to receive flooring shall be clean, fully enclosed, weather tight with stable environmental conditions between 65 degrees F – 81 degrees F, and 50% (± 10%) relative humidity for 48 hours before during and continuously after installation.

F. Close spaces to traffic during floor tile installation.

G. Close spaces to traffic for 48 hours after floor tile installation.

H. Install floor tile after other finishing operations, including painting, have been completed.

1.5 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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 SOLID VINYL FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, provide products matching the adjacent flooring by one of the following manufacturers:
   1. Mannington Mills
   2. Johnsonite
   3. Armstrong
   4. Tarkett

B. Tile Standard: ASTM F 1700, Class 3, Printed Film Vinyl Tile.

C. Wearing Surface: to match adjacent

D. Thickness: to match adjacent

E. Size: to match adjacent

F. Colors and Patterns: As selected by Architect from full range of industry colors.

G. Patterns: Confirm in shop drawings.

2.2 VINYL COMPOSITION FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, provide products matching the adjacent flooring by one of the following manufacturers:
   1. Mannington Mills
   2. Johnsonite
   3. Armstrong
   4. Tarkett

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Wearing Surface: to match adjacent

D. Thickness: to match adjacent

E. Size: to match adjacent

F. Colors and Patterns: As selected by Architect from full range of industry colors.

G. Patterns: Confirm in shop drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. LVT adhesives: Not more than 50 g/L.

2. VCT adhesives: Manufacturer recommend products.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

D. Metal Edge Strips: Install at all floor transitions from LVT/rubber to other material. Schluter Systems Approved by Architect. Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Flooring contractor is responsible for all surface preparation necessary at new and existing concrete slabs for installation of resilient flooring meeting warranty requirements, this includes but is not limited to crack repair, control joint repair, hole filling, leveling. No additional costs will be considered for floor prep.

B. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

C. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer and as follows. Proceed with installation only after substrates pass testing.

1. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
2. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor 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 tile at perimeter.

1. Lay tiles in pattern indicated.

2. VCT: Roll floor using 100 lb. roller in both directions within 1 hour of installation.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Cover floor tile until Substantial Completion.

C. VCT Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coats

END OF SECTION 096519

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SECTION 099113 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on exterior substrates.

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Wood.
5. Plastic trim fabrications.
6. Exterior gypsum board.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this section.
2. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
3. Section 099600 "High-Performance Coatings" for tile-like coatings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Label each coat of each Sample.

3. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Indicate VOC content.

1.4 CLOSEOUT SUBMITTALS

A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. of each material and color applied.

1.6 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 manufacture’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. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

D. Hazardous Materials: Hazardous materials including lead paint [**are**] [**may be**] present in buildings and structures to be painted. A report on the presence of known hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified.
2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); products indicated or comparable product from one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Coatings.
3. Valspar Corporation - Architectural (Pro).

B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 "Product Requirements," and the following:

1. Products are approved by manufacturer in writing for application specified.
2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.

C. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. 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: For field applications, provide paints and coatings that complies with VOC content limits of authorities having jurisdiction.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 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 paints 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

3.1 EXAMINATION

A. 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.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Fiber-Cement Board: 12 percent.

c. Masonry (Clay and CMU): 12 percent.
d. Wood: 15 percent.
e. Portland Cement Plaster: 12 percent.
f. Gypsum Board: 12 percent.

2. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
3. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. 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:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. 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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. 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.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project 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.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete, Clay Masonry, Cementitious Siding, Nontraffic Surfaces:

1. Latex System:

a. Prime Coat: Primer sealer, latex.

1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.

b. Prime Coat: Latex, exterior, matching topcoat.
c. Intermediate Coat: Latex, exterior, matching topcoat.

d. Topcoat: Latex, exterior, semi-gloss.

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

B. CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior/exterior:

1) S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal..

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, semi-gloss.

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

C. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

a. Prime Coat: Primer, latex for exterior wood.

1) S-W Exterior Latex Primer, B42, at 4.0 mils wet, 1.4 mils dry, per coat.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, semi-gloss:

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

D. Plastic Trim Fabrication Substrates: Including architectural PVC, plastic, and fiberglass items.

1. Latex System:

a. Prime Coat: Primer, bonding, water-based:

1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils wet, 1.4 mils dry.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, semi-gloss:

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

E. Exterior Gypsum Board Substrates:

1. Latex System:

a. Prime Coat: Primer bonding, water-based.

1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils wet, 1.4 mils dry.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, satin:

1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on interior substrates.

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Wood.
5. Gypsum board.
6. Plaster.
7. Spray-textured ceilings.
8. Cotton or canvas insulation covering.
9. ASJ insulation covering.
10. Glazed Block.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this section.
2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
3. Section 099600 "High-Performance Coatings" for tile-like coatings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. 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 square.
2. Label each coat of each Sample.
3. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Indicate VOC content.

1.4 CLOSEOUT SUBMITTALS

1. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 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. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Lead Paint: It is not expected that lead paint will be encountered in the Work.

1. If suspected lead paint is encountered, do not disturb; immediately notify Architect and Owner.

D. Lead Paint: Lead paint may be present in buildings and structures to be painted. A report on the presence of lead paint is on file for review and use. Examine report to become aware of locations where lead paint is present.

1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified.
2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); products indicated or comparable product from one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Coatings.
3. Pratt & Lambert.
4. Valspar Corporation - Architectural (Pro).

B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 "Product Requirements," and the following:

1. Products are approved by manufacturer in writing for application specified.
2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.

C. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. 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 of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Flat Topcoat Paints: VOC content of not more than 50 g/L.
6. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
7. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
8. Floor Coatings: VOC not more than 100 g/L.
9. Shellacs, Pigmented: VOC not more than 550 g/L.
10. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
11. Dry-Fog Coatings: VOC content of not more than 400 g/L.
12. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
13. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.
    i. Di-n-octyl phthalate.
    j. 1,2-dichlorobenzene.

k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

D. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E3.

2.4 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 3.

B. Interior Alkyd Primer/Sealer: MPI #45.

1. VOC Content: E Range of E2.

2.5 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based): MPI #107.

1. VOC Content: E Range of E3.

2.6 LATEX PAINTS

A. High-Performance Architectural Latex (Eggshell): MPI #139 (Gloss Level 3).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: [EPR 5].
3. Three coat minimum.

2.7 ALKYD PAINTS

A. Interior Alkyd (Flat): MPI #49 (Gloss Level 1).

1. VOC Content: E Range of E3.

B. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).

1. VOC Content: E Range of E2.

2.8 FLOOR COATINGS

A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.

1. VOC Content: E Range of E3.

2.9 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

3.1 EXAMINATION

A. 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.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

    a. Concrete: 12 percent.
    b. Masonry (Clay and CMU): 12 percent.
    c. Wood: 15 percent.
    d. Gypsum Board: 12 percent.
    e. Plaster: 12 percent.

2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
3. Plaster Substrates: Verify that plaster is fully cured.
4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. 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:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. 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.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI 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.

B. 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.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. 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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. 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.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project 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.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces (Minimum three coats):

1. Alkyd System: MPI INT 3.1D.

    a. Prime Coat: Interior latex primer/sealer.
    b. Intermediate Coat: Interior alkyd matching topcoat.
    c. Topcoat: Interior alkyd eggshell

2. Clear Sealer System: MPI INT 3.2F.

    a. First Coat: Interior/exterior clear concrete floor sealer (solvent based).
    b. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).

B. CMU Substrates (Minimum three coats):

1. High-Performance Architectural Latex System: MPI INT 4.2D.

    a. Prime Coat: Interior/exterior latex block filler.
    b. Intermediate Coat: High-performance architectural latex matching topcoat.
    c. Topcoat: High-performance architectural latex eggshell.

C. Glazed Block Substrates
1. Water Based two part Epoxy (Minimum three coats)
    a. Basis of Design Product: Sherwin Williams Pro Industrial Water Based Catalyzed Epoxy

D. Steel Substrates (Minimum three coats):

1. High-Performance Architectural Latex System: MPI INT 5.1R.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: High-performance architectural latex matching topcoat.
    c. Topcoat: High-performance architectural latex eggshell.

E. Gypsum Board Substrates (Minimum three coats):

1. Latex System: walls

    a. Prime Coat: Interior latex primer/sealer and matching topcoat
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex eggshell.

F. Gypsum Board Substrates: soffit conditions

1. Latex System:

a. Prime Coat: Interior latex primer/sealer and matching topcoat
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex flat

END OF SECTION 099123

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SECTION 099600 - HIGH-PERFORMANCE COATINGS

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 surface preparation and the application of high-performance coating systems.

1. Exterior Substrates:

a. Concrete, horizontal surfaces.
b. Steel.
c. Galvanized metal.
d. Aluminum (not anodized or otherwise coated).

2. Interior Substrates:

a. Concrete, horizontal surfaces.
b. Steel.
c. Galvanized metal.
d. Aluminum (not anodized or otherwise coated).

B. Related Requirements:
1. Section 099113 "Exterior Painting" for general field painting.
2. Section 099123 "Interior Painting" for general field painting.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.

2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

C. Samples for Initial Selection: For each type of topcoat product indicated.

D. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated 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 coating system.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft..
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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tnemec Company, Inc.; products as scheduled or comparable product by one of the following:

1. PPG Architectural Coatings.
2. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

B. VOC Content: For field applications[**that are inside the weatherproofing system**], paints and coatings shall comply with VOC content limits of authorities having jurisdiction, and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Floor Coatings: 100 g/L.
5. Waterproofing Sealers: 250 g/L
6. Sealers: All other sealers, 200 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating 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 coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain and follow manufacturer's written instructions for examination and testing of substrates.

1. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
2. Verify that substrate surfaces are ready to receive work as instructed in writing by coating manufacturer.

B. Proceed with coating application when substrates have been properly prepared, but only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: 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.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.

E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

F. 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:

1. SSPC-SP 6/NACE No. 3.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

I. Aluminum Substrates: Remove loose surface oxidation. Brush-off blast according to SSPC-SP 16.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.

2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces:

1. Epoxy Non-Slip Deck Coating System:

    a. Prime Coat: As recommended in writing by topcoat manufacturer.
    b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
    c. Topcoat: Epoxy deck coating (slip resistant).

B. Steel Substrates:

1. Zinc, Epoxy, Polyurethane or Polycarbamide System:

    a. Prime Coat: Primer, shop-applied zinc, anti-corrosive, for metal.

        1) Tnemec Company, Inc.; Series 94-H20 Hydro-Zinc; DFT 2.5 to 3.5 mils .

    b. Intermediate Coat: Epoxy, satin.

        1) Tnemec Company, Inc.; Series 66HS Hi-Build Epoxoline; DFT 2.0 to 3.0 mils .

    c. Topcoat: Polyurethane.

        1) Tnemec Company, Inc.; Series 1080 Endura-Shield (gloss); DFT 2.0 to 3.0 mils .

C. Galvanized-Metal Substrates:

1. Pigmented Polyurethane over Epoxy Primer System:

    a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.

        1) Tnemec Company, Inc.; Series 66HS Hi-Build Epoxoline; DFT 3.0 to 5.0 mils .

    b. Topcoat: Polyurethane, two component, pigmented.

        1) Tnemec Company, Inc.; Series 1081 Endura-Shield (semi-gloss); DFT 2.0 to 3.0 mils .

D. Stainless-Steel Substrates:

1. Pigmented Polyurethane System:

    a. Prime Coat: Primer, epoxy.

        1) Tnemec Company, Inc.; Series 66HS Hi-Build Epoxoline; DFT 2.0 to 3.0 mils .

    b. Topcoat: Polyurethane, two component, pigmented.

        1) Tnemec Company, Inc.; Series 1081 Endura-Shield (semi-gloss); DFT 2.0 to 3.0 mils .

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces.

1. Epoxy System, 100 Percent Solids:

a. Prime Coat: Epoxy.

1) Tnemec Company, Inc.; Series 201 Epoxoprime; DFT 10.0 to 12.0 mils .

b. Intermediate Coat: Epoxy, matching topcoat.

1) Tnemec Company, Inc.; Series 280 Tneme-Glaze; DFT 6.0 to 8.0 mils .

c. Topcoat: Epoxy, gloss-orange peel.

1) Tnemec Company, Inc.; Series 280 Tneme-Glaze; DFT 6.0 to 8.0 mils .

B. Steel Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.

1) Tnemec Company, Inc.; Series 66HS Hi-Build Epoxoline; DFT 3.0 to 5.0 mils .

b. Topcoat: High-solids, polyamide epoxy, satin.

1) Tnemec Company, Inc.; Series 66HS Hi-Build Epoxoline; DFT 4.0 to 6.0 mils .

C. Galvanized-Metal Substrates:

1. Zinc-Rich Urethane over Acrylic System:

a. Prime Coat: Zinc-rich, anti-corrosive, for metal.

1) Tnemec Company, Inc.; Series 94-H20 Hydro-Zinc; DFT 2.5 to 3.5 mils .

b. Intermediate Coat: Self-crosslinking, hydrophobic, acrylic, eggshell, matching topcoat.

c. Topcoat: Self-crosslinking, hydrophobic, acrylic, eggshell.

1) Tnemec Company, Inc.; Series 115 Uni-Bond DF; DFT 2.5 to 3.5 mils .

D. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Acrylic System:

a. Prime Coat: Primer, Self-crosslinking, hydrophobic, acrylic.

1) Tnemec Company, Inc.; Series 115 Uni-Bond DF; DFT 2.0 to 3.0 mils .

b. Topcoat: Self-crosslinking, hydrophobic, acrylic, eggshell.

1) Tnemec Company, Inc.; Series 115 Uni-Bond DF; DFT 2.0 to 3.0 mils .

E. Copper Substrates:

1. Epoxy System:

a. Prime Coat: Primer, vinyl wash.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss.

F. Stainless-Steel Substrates:

1. Epoxy System:

a. Prime Coat: Primer, vinyl wash.

b. Intermediate Coat: Epoxy, matching topcoat.
c. Topcoat: Epoxy, gloss.

END OF SECTION 099600

CORDOGAN CLARK & ASSOCIATES, INC.
515 REDWOOD DRIVE
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SECTION 211313 - WET-PIPE SPRINKLER 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. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. 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-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

    a. Automobile Parking Areas: Ordinary Hazard, Group 1.
    b. Building Service Areas: Ordinary Hazard, Group 1.
    c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    d. General Storage Areas: Ordinary Hazard, Group 1.
    e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    f. Office and Public Areas: Light Hazard.

3. 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.

4. Maximum Protection Area per Sprinkler: Per UL listing.
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. Ordinary-Hazard Occupancies: 250 gpm.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

E. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.

2. Storm lines

3. Vent lines

4. Waste lines
5. Compressed air piping.
6. HVAC hydronic piping.
7. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

8. Ductwork.

1.7 INFORMATION SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Fire-hydrant flow test report.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Field quality-control reports.

F. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

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. All warranties shall be for 12 months from the date of Substantial Completion, unless a longer time period is required.

D. NFPA Standards: Sprinkler 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."

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 DEMOLITION

A. The drawings are intended to indicate the new scope of work required and do not indicate all work that must be removed to accommodate the renovation. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and 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 used on Project.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTER

A. Reduced pressure detector assembly, outside stem and yoke valves

B. Backflow preventer shall be UL listed and meet the following standards: ASSE 1047, AWWA C511-97.

2.2 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.3 STEEL PIPE AND FITTINGS (UL Listed and FM approved)

A. Schedule 10 Black-Steel Pipe: ASTM A135, Type E, Grade A

B. Schedule 40 Black-Steel Pipe: ASTM A795, Type E, Grade A

C. Schedule 40 Black-Steel Pipe: ASTM A53, Type E, Grade B

D. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

E. Uncoated, Steel Couplings: ASTM A 865, threaded.

F. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

G. Ductile Iron Threaded Fittings: ASME B16.3, Class 150

H. Malleable- or Ductile-Iron Unions: UL 860.

I. Cast-Iron Flanges: ASME 16.1, Class 125.

J. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

K. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

L. Grooved-Joint, Steel-Pipe Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Grooved-End Fittings for Steel Piping: ASTM A536, ductile-iron casting, rust inhibiting paint; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: ASTM A536, rust inhibiting paint, rigid pattern unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts. Grade E EPDM gasket.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Milwaukee Valve Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. Fivalco Inc.
    c. Global Safety Products, Inc.
    d. Kennedy Valve; a division of McWane, Inc.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Pratt, Henry Company.
    h. Shurjoint Piping Products.
    i. Tyco Fire & Building Products LP.
    j. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFAC Inc.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Globe Fire Sprinkler Corporation.
    e. Kennedy Valve; a division of McWane, Inc.
    f. Mueller Co.; Water Products Division.
    g. NIBCO INC.
    h. Reliable Automatic Sprinkler Co., Inc.
    i. Tyco Fire & Building Products LP.
    j. United Brass Works, Inc.
    k. Victaulic Company.
    l. Viking Corporation.

2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate 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; Stockham Division.
    c. Milwaukee Valve Company.
    d. NIBCO INC.

2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
    b. American Valve, Inc.
    c. Clow Valve Company; a division of McWane, Inc.
    d. Crane Co.; Crane Valve Group; Crane Valves.
    e. Crane Co.; Crane Valve Group; Jenkins Valves.
    f. Crane Co.; Crane Valve Group; Stockham Division.
    g. Milwaukee Valve Company.
    h. Mueller Co.; Water Products Division.
    i. NIBCO INC.

j. Tyco Fire & Building Products LP.
k. United Brass Works, Inc.
l. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:

a. Valve Type: Ball or butterfly.
b. Body Material: Bronze.
c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:

a. Valve Type: Butterfly.
b. Body Material: Cast or ductile iron.
c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch indicating device.

I. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Stockham Division.
b. Kennedy Valve; a division of McWane, Inc.
c. Mueller Co.; Water Products Division.
d. NIBCO INC.
e. Tyco Fire & Building Products LP.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.

4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO
b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Stewart, M. A. and Sons Ltd.
f. Tyco Fire & Building Products LP.
g. Victaulic Company.
h. Watts Water Technologies, Inc.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fire Protection Products, Inc.
b. United Brass Works, Inc.

2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFAC Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Storz-Type, Fire-Department Connection: (Prior to order, contractor to verify with the local AHJ)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. GMR International Equipment Corporation.
d. Guardian Fire Equipment, Inc.
e. Potter Roemer.

2. Standard: UL 405.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Corrosion-resistant metal.
5. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
6. Caps: Brass, lugged type, with gasket and chain.
7. Escutcheon Plate: Rectangular, brass, wall type.
8. Outlet: With pipe threads.
9. Body Style: Horizontal.
10. Number of Inlets: One.
11. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
12. Finish: Polished chrome plated.
13. Outlet Size: 4”.

2.9 SPRINKLER SPECIALTY PIPE FITTINGS

A. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGF Manufacturing Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

B. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGF Manufacturing Inc.
b. Tyco Fire & Building Products LP.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.10 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:
1. Characteristics: Nominal 3/4-inch orifice with Discharge Coefficient K of 8.0, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Bronze.

E. 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: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. System Sensor.
b. Notifier; a Honeywell company.
c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum- inside, 10-inch minimum outside diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Potter Electric Signal Company.
b. System Sensor; a Honeywell company.
c. Viking Corporation.

2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: 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.

5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Potter Electric Signal Company.
b. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.12 PRESSURE GAGES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. AMETEK; U.S. Gauge Division.
3. Ashcroft, Inc.
4. Brecco Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 300 psig.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

2.13 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw.

C. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

D. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.14 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

2.15 SLEEVE SEALS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Advance Products & Systems, Inc.
3. Calpico, Inc.
4. Metraflex, Inc.
5. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe 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.

2.16 GROUT

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink, and 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 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.3 PIPING INSTALLATION

A. 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.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. 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.

N. Where ceilings, walls, structures, ect. are temporarily removed and replaced by others, this contractor shall be responsible for the removal, salvage, and re-installation of piping, heads, ect.

O. Fill sprinkler system piping with water.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.7 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.8 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

H. Seal space outside of sleeves in concrete slabs and walls with grout.

I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.

    a. Extend sleeves 2 inches above finished floor level.
    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
3. Sleeves for Piping Passing through Exterior Concrete Walls:

    a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
    c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

4. Sleeves for Piping Passing through Interior Concrete Walls:

    a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

K. 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 firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.10 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems 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.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.13 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.15 PIPING SCHEDULE

A. 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.

B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

C. Main Pipe, Standard-pressure, wet-pipe sprinkler system, shall be the following:

1. Schedule 10 black-steel pipe with roll-grooved ends; grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Branch Pipe, Standard-pressure, wet-pipe sprinkler system, shall be the following:

1. Schedule 40, Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

3.16 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Penal areas: Institutional anti-suicide.
5. Provide protective cages for sprinkler heads in areas where unprotected sprinkler heads may be subject to impact or damage.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; PTFE coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 GENERAL INFORMATION

A. The plans are diagrammatic and indicate design intent and general arrangement of mechanical equipment. The contractor shall verify conditions on site and notify the engineer of any discrepancy prior to installing work.

B. The plans do not depict every offset, fitting, accessory, etc. that may be required to provide a complete and functional plumbing system. Where such items are required to provide a complete and functional plumbing system, they shall be provided, whether or not depicted on the plans.

C. Where a BIM model is provided to the contractor, it shall be used for reference only and does not supersede the plan sheets; the plan sheets and specifications shall remain as the contract documents.

D. Coordination: The contractor shall coordinate all work with other contractors and subcontractors so that various components of the plumbing system will be installed at the proper time, will fit the available space, and will allow proper service access to all equipment. The contractor shall refer to architectural, structural, electrical, fire protection, and mechanical drawings and relevant equipment drawings to determine the extent of clear spaces. The contractor shall make all offsets required to clear equipment, beams, and other structural members, and to facilitate concealing piping in the manner anticipated in the design. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finish actually installed.

E. Value Substitutions: (VE)

1. The contractor is completely responsible for all substitutions, changes, or deletions of work or products proposed to and accepted by the owner or architect in lieu of specified and shall hold the owner and architect harmless for any liabilities created by such changes. As much as is possible, such proposals for change shall indicate how the specified design goals, the work of other trades, and the construction schedule are expected to be impacted. The contractor is responsible for research of all codes and standards applicable to the proposed change, professional design services necessary to implement the change, re-submittals for state and municipal permits and additional fees invoked by the change, and notification of and coordination with other trades impacted by the change. After acceptance of a change proposal by the owner or architect, the contractor shall notify them within ten calendar days of any unexpected, discovered conditions that may impact the work. After this period, the contractor shall not be excused from any liabilities created by their own proposed change(s) and shall be responsible for any discovered costs incurred by anyone due to the change(s).

F. Plumbing equipment and piping indicated as “existing to remain” shall be protected during demolition and construction so that it remains functional at project completion. If existing to remain equipment is rendered non-functional by construction activities, the contractor shall repair or replace such equipment at no cost to the owner.

G. Where seismic drawings, calculations and details for any anchorage, bracing, and/or sway bracing are indicated as a delegated design item, the contractor shall engage a Professional Engineer to provide sealed drawings and submit this information to the authority having jurisdiction as well as to the engineer of record.

H. Plumbing demolition:
   1. The drawings are intended to indicate the scope of work required and do not indicate all work that must be removed to accommodate the renovation. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
   2. Demolition of domestic water line(s), waste pipe, and vent pipes shall removed and capped back to the main service line so a dead-end condition is not created.
   3. Demolition and remodel work is to be phased according to areas indicated on the drawings.
   4. Coordinate outages to occur at a time most convenient to the owner.
   5. Scope and verify existing conditions as required to remove and/or connect to existing services.

I. All plumbing submittals shall be submitted concurrently as part of a complete package. Submittals will not be reviewed until a complete package has been provided.

J. The contractor shall drain and fill the existing systems as required to install work as a part of this project. Contractor shall install additional shut-off valves and drain valves as needed to perform work.

K. Unless otherwise noted on the architectural drawings, contractor shall cut, patch, and match existing building construction to remove and install work as required.

L. Where ceilings, walls, structures, ect. are temporarily removed and replaced by others, this contractor shall be responsible for the removal, salvage, and re-installation of equipment, fixtures, piping, ect.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 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. Supports and anchorages.

1.4 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, 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.

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 plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Product Data: For the following in pdf format:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.6 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 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.

1.7 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.

1.8 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.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: 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.

C. 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.

D. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.

E. 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 PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. 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, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. 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.

PART 3 - EXECUTION

3.1 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 in exposed rooms above bottom bar joist.

G. Install piping to permit valve servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Install piping to allow application of insulation.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. 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 Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

N. Sleeves are not required for core-drilled holes.

O. Permanent sleeves are not required for holes formed by removable PE sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

Q. 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.

R. 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.

S. 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.

T. 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.

U. Verify final equipment locations for roughing-in.

V. 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 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. Plastic 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. 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.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

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 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.

3.5 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.

3.6 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

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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 ball valves.
2. Iron, single-flange butterfly valves.
3. Iron, grooved-end butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Bronze gate valves.
7. Bronze globe valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

2. Section 220719 – Plumbing Piping Insulation
3. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
4. Section 221513 "General-Service Compressed-Air Piping" for valves applicable only to this 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 INFORMATIONAL 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.

D. Compliance with the current Federal NO-LEAD Standard.

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, gate, 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. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves - Full Port with Stainless Steel Ball and Stem:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Milwaukee Valve Company
b. Nibco
c. Watts
d. Apollo

2. Description:

a. Standard: MSS-SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded, soldered, or press fit.
f. Seats: PTFE
g. Stem: Stainless steel
h. Ball: Stainless steel
i. Port: Full.

2.3 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. Crane
b. Milwaukee Valve Company.
c. Nibco
d. Watts

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.

2.4 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kennedy Valve; a division of McWane, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig.
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

2.5 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane
b. Milwaukee Valve Company
c. NIBCO INC
d. Watts

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: Silicon Bronze ASTMB584 Alloy C87850
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.
g. Must be non-slam/silent type

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. Crane
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Watts

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal and Vertical flow.
d. Body Material: Silicon Bronze ASTMB584 Alloy C87850
e. Ends: Threaded.
f. Disc Holder: Silicon Bronze ASTMB584 Alloy C87850

g. Seat Disc: PTFE
h. Disc Hanger: Silicon Bronze ASTMB584 Alloy C87850
i. Must be non-slam/silent type

2.7 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: Silicon Bronze ASTMB584 Alloy C87850
d. Ends: Threaded.
e. Stem: Bronze.
f. Bonnet: Silicon Bronze ASTMB584 Alloy C87850
g. Packing Gland: Bronze ASTMB62 or ASTM B584 Alloy C84400 or Bass ASTMB16.
h. Wedge: Silicon Bronze ASTMB584 Alloy C87850
i. Handwheel: Malleable Iron ASTM A47(T-113)

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
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts

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.

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. Provide and install shutoff valves at all branch takeoffs.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. 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, butterfly, or gate valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe 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 with spring or iron, center-guided, metal-seat 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 Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
5. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 DOMESTIC, HOT-AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 3 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.

B. Pipe NPS 4 and Larger:
1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, ductile-iron disc.
2. Iron, Grooved-End Butterfly Valves: 175 CWP.

END OF SECTION 220523

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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. Section Includes:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.

B. Related Sections:
1. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing 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.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

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.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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 trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel 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.

PART 2 - PRODUCTS

2.1 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. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. Globe Pipe Hanger Products, Inc.
7. Grinnell Corp.
8. GS Metals Corp.
9. National Pipe Hanger Corporation.
10. PHD Manufacturing, Inc.
11. PHS Industries, Inc.
12. Piping Technology & Products, Inc.
13. Tolco Inc.

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.

2.2 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. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. 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.

2.4 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 or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

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 (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, 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. 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.

2.6 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.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, 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. 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.

B. 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.

C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. 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.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. 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.

I. 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.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. 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.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. 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.

O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. 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.

Q. 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.

3.2 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/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 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. 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.
3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
6. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
7. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
8. 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.
9. 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.
10. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
11. 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.

12. 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.
13. 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.
14. 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.
15. 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): 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 mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.4 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 PAINTING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting."

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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.

Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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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. Pipe labels.
   2. Valve tags.

1.3 ACTION 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: Green.
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: 1/2 inch.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Snap on Pipe Labels: Printed plastic pre coiled for application without requiring adhesive or tape. Provide zip ties for pipe labels installed on piping with an outer diameter greater than 6".

C. 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.

2.3 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 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.

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. 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.

B. Pipe Label Color Schedule:

1. Domestic Cold Water Piping:

   a. Background Color: Green
   b. Letter Color: White.

2. Domestic Hot Water Piping:

   a. Background Color: Green
   b. Letter Color: White

3. Sanitary Piping:

   a. Background Color: Green
   b. Letter Color: White.

4. Vent Piping:

a. Background Color: Green
b. Letter Color: White

5. Storm Piping:

a. Background Color: Green
b. Letter Color: White.

6. Compressed Air Piping:

a. Background Color: Blue
b. Letter Color: White.

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: 2 inches, round
b. Hot Water: 2 inches, round

2. Valve-Tag Color:

a. Cold Water: Green.
b. Hot Water: Green.

3. Letter Color:

a. Cold Water: White.
b. Hot Water: White.

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

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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. Supplies and drains for handicap-accessible lavatories and sinks.
5. Storm lines and overflows.
6. Roof drain bodies.

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 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.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Jacket Materials for Pipe: 12 inches long by NPS 2.
3. Sheet Jacket Materials: 12 inches square.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

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.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Piping Mockups:

a. One 10-foot section of NPS 2 straight pipe.
b. One each of a 90-degree threaded, welded, and flanged elbow.
c. One each of a threaded, welded, and flanged tee fitting.
d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
e. Four support hangers including hanger shield and insert.
f. One threaded strainer and one flanged strainer with removable portion of insulation.
g. One threaded reducer and one welded reducer.
h. One pressure temperature tap.

i. One mechanical coupling.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

D. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

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 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.

1.8 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 Part 3 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. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 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, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA

2. Elastomeric insulation for exterior use: Armacell Armaflex with Alumaguard jacket.

2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

C. ASJ Adhesive, and FSK and PVDC 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 the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2.3 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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.4 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 the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
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.

2.5 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.6 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.

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. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. 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 **4 inches** o.c.

    a. 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 and polyolefin, 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 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.

3.7 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.

3.8 INDOOR CONTINOUS PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. All sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Re-circulated Hot Water:

1. Sizes (less than or equal to 1-1/4): Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. Sizes (1-1/2 inch and larger): Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.

C. Domestic Hot and Re-circulated Hot Water (Underground)

1. Sizes (less than or equal to 1-1/4): Insulation shall be the following:

a. Flexible elastomeric: 1 inch thick.

2. Sizes (1-1/2 inch and larger): : Insulation shall be the following:

a. Flexible elastomeric: 1-1/2 inch thick.

D. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

E. Roof Drain and Overflow Drain Bodies:

1. Insulation shall be the following:

a. Flexible elastomeric: 1 inch thick.

F. Stormwater and Overflow Pipe:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.9 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, provide elastomeric insulation and Schedule 40 PVC pipe conduit.

END OF SECTION 220719

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SECTION 221116 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by Contractor.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Product Data: For pipe, tube, fittings, and couplings.

C. System purging and disinfecting activities report.

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 Owner no fewer than FIVE WORKING days in advance of proposed interruption of water service.
2. Do not interrupt water service without Construction Manager's written permission.

1.6 QUALITY ASSURANCE

A. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

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 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 220, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper tube and fittings to be made in USA.

2.3 GALVANIZED-STEEL PIPE AND FITTINGS

A. Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B, Standard Weight. Include ends matching joining method.

1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
3. Malleable-Iron Unions: ASME B16.39, Class 220, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
4. Flanges: ASME B16.1, Class 125, cast iron.

2.4 VALVES

A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "Valves."

B. Balancing and drain valves are specified in Division 22 Section "Plumbing Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPE AND FITTING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube, Type K; wrought copper fittings; and soldered joints.

E. Aboveground domestic water piping, NPS 4 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; Wrought - copper solder-joint fittings; and solder joints.
2. Hard copper tube, ASTM B 88, Type L; copper press fittings, ASME B16.18/16.22; and press connect joints. (Viega ProPress or equal)

F. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water-Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. Install balancing valve and check valve in each hot-water circulation return branch. Install non-slam check valve on discharge side of pumps. Install circuit setter downstream of circulation pump where pumps are not capable of being set to maintain a flow setpoint. Set balancing

valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Balancing valves are specified in Division 22 Section "Plumbing Specialties."

E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Plumbing Specialties."

3.4 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. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. 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 Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. 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.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. 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.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install PEX piping with loop at each change of direction of more than 90 degrees.

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 Section 220519 "Meters and Gages for Plumbing Piping."

U. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

V. Install thermometers on[inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "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 Section 220517 "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 Section 220518 "Escutcheons for Plumbing Piping."

Z. If using press connect fitting system, leave behind one press tool for owner’s use after project completion.

3.5 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. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

E. Press Connect Joints shall be made in accordance with manufacturer's installation instructions.

F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports." 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: MSS Type 49, spring cushion rolls, if indicated.

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.

B. Install supports according to Division 22 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. 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.

F. Install supports for vertical steel piping every 22 feet.

G. 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.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow 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, and extend and connect to the following:

1. Water Heaters: Cold-water supply 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 required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
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 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. 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:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. 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.
3. 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.
4. 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.
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.

3.9 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 flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used 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.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

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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. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated, water mixing valves.
5. Strainers.
6. Hose bibbs.
7. Drain valves.
8. Air vents.
9. Expansion tanks. (ASME Rated)
10. Water Hammer arrester
11. Trap-seal primer device

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 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: Rough bronze.

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. Legend Valve.
    e. MIFAB, Inc.

f. Prier Products, Inc.
g. Watts Industries, Inc.; Water Products Div.
h. Woodford Manufacturing Company.
i. Zurn Plumbing Products Group; Light Commercial Operation.
j. 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] [Rough bronze].

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. Flo Fab Inc.
   b. ITT Industries; Bell & Gossett Div.
   c. NIBCO INC.
   d. TAC Americas.
   e. Taco, Inc.
   f. Watts Industries, Inc.; Water Products Div.

2. Type: Ball valve with two readout ports and memory setting indicator.
3. Body: Brass ASTM B283-C69300
4. Size: Same as connected piping, but not larger than NPS 2.

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. Cash Acme
   b. Symmons Industries, Inc.
   c. Watts Industries, Inc.; Water Products Div.

B. Individual-Fixture, Water Tempering Valves

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: 110 deg F..

8. Tempered-Water Design Flow Rate: Refer to faucet

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 that complies with AWWA C550 or that is FDA approved, epoxy coated 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. Drain: Factory-installed, hose-end drain valve.

2.7 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.

2.8 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.9 ASME RATED EXPANSION TANK

A. Manufacturers:
1. Bell & Gossett
2. Amtrol
3. Grundfos

B. See plans for description.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
   1. Standard: ASSE 1010 or PDI-WH 201.
   2. Type: Piston
   3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:
   1. Standard: ASSE 1018.
   2. Pressure Rating: 125 psig minimum.
   3. Body: Bronze.
   4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
   5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
   6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:
   1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
   2. Size: NPS 1-1/4 minimum.
   3. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Install balancing valves in locations where they can easily be adjusted.

C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

D. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

E. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

F. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

G. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

H. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

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.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

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. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Calibrated balancing valves.
11. Manifold, thermostatic, water mixing-valve assemblies.
12. Photographic-process, thermostatic, water mixing-valve assemblies.
13. Primary water tempering valves.
14. Outlet boxes.

15. Hose stations.
16. Supply-type, trap-seal primer valves.
17. Trap-seal primer systems.

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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

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

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SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 GENERAL INFORMATION

A. The permanent HVAC systems shall not be used for temporary heating and cooling during construction in the area of work unless the owner has received a written request from the contractor for such usage and has provided written consent.
   1. If the owner has agreed in writing with the use of the permanent HVAC system during construction, the following conditions will be followed:
      a. All safety devices shall be installed and operational.
      b. Temporary filters shall be installed in the filter section. These filters shall be replaced monthly.
      c. Air handling equipment shall be configured to use 100% outside air rather than recirculated air.
      d. At the start of substantial completion, contractor shall change all filters, clean all coils, equipment, supply air ducts, return air ducts, and transfer ducts to the satisfaction of the architect, engineer, and owner.

B. The plans are diagrammatic and indicate design intent and general arrangement of mechanical equipment. The contractor shall verify conditions on site and notify the engineer of any discrepancy prior to installing work.

C. The plans do not depict every offset, fitting, accessory, etc. that may be required to provide a complete and functional mechanical system. Where such items are required to provide a complete and functional mechanical system, they shall be provided, whether or not depicted on the plans.

D. Where a BIM model is provided to the contractor, it shall be used for reference only and does not supersede the plan sheets; the plan sheets shall remain as the contract documents.

E. Coordination: The contractor shall coordinate all work with other contractors and subcontractors so that various components of the mechanical system will be installed at the proper time, will fit the available space, and will allow proper service access to all equipment. The contractor shall refer to architectural, structural, electrical, fire protection, and plumbing drawings and relevant equipment drawings to determine the extent of clear spaces. The contractor shall make all offsets required to clear equipment, beams, and other structural members, and to facilitate concealing piping and ductwork in the manner anticipated in the design. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finish actually installed.

F. Value Substitutions: (VE)

1. The contractor is completely responsible for all substitutions, changes, or deletions of work or products proposed to and accepted by the owner or architect in lieu of specified and shall hold the owner and architect harmless for any liabilities created by such changes. As much as is possible, such proposals for change shall indicate how the specified design goals, the work of other trades, and the construction schedule are expected to be impacted. The contractor is responsible for research of all codes and standards applicable to the proposed change, professional design services necessary to implement the change, re-submittals for state and municipal permits and additional fees invoked by the change, and notification of and coordination with other trades impacted by the change. After acceptance of a change proposal by the owner or architect, the contractor shall notify them within ten calendar days of any unexpected, discovered conditions that may impact the work. After this period, the contractor shall not be excused from any liabilities created by their own proposed change(s) and shall be responsible for any discovered costs incurred by anyone due to the change(s).

G. Mechanical equipment indicated as "existing to remain" shall be protected during demolition and construction so that it remains functional at project completion. If existing to remain equipment is rendered non-functional by construction activities, the contractor shall repair or replace such equipment at no cost to the owner.

H. Mechanical demolition:
1. The drawings are intended to indicate the scope of work required and do not indicate all work that must be removed to accommodate the renovation. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
2. Demolition of ductwork or piping shall be removed and patched/capped back to the main service line as required to maintain system operation.
3. Demolition and remodel work is to be phased according to areas indicated on the drawings.
4. Coordinate outages to occur at a time most convenient to the owner.
5. Existing sensors / thermostats installed in existing walls, to be removed, shall be relocated to the nearest remaining wall.
6. Thermostat / sensor wire shall be replaced as needed to allow full function of the new mechanical equipment.

I. Where seismic drawings, calculations and details for any anchorage, bracing, and/or sway bracing are indicated as a delegated design item, the contractor shall engage a Professional Engineer to provide sealed drawings and submit this information to the authority having jurisdiction as well as to the engineer of record.

J. All mechanical submittals shall be submitted concurrently as part of a complete package. Submittals will not be reviewed until a complete package has been provided.

K. The contractor shall pay all shipping charges, freight charges, and expediting fees as required to install work per the construction schedule.

L. The contractor shall drain, fill, and treat the existing hydronic systems as required to install work as a part of this project. Contractor shall install additional shut-off valves, drain valves, air vents, and tees for control sensors as needed to perform work. Contractor shall dispose of the fluid per local AHJ requirements.

M. Unless otherwise noted on the architectural drawings, contractor shall cut, patch, and match existing building construction to remove and install work as required.

N. Where ceilings, walls, structures, ect. are temporarily removed and replaced by others, this contractor shall be responsible for the removal, salvage, and re-installation of mechanical equipment, diffusers, controls, etc.

1.2 SUMMARY

A. Section Includes:
1. Expansion joints.
2. Alignment guides and anchors.
3. Sleeves without waterstop.
4. Sleeves with waterstop.
5. Stack-sleeve fittings.
6. Sleeve-seal systems.
7. Grout.
8. Escutcheons.
9. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product data.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators in accordance with 2021 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 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 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

A. Performance Requirements:

1. Compatibility: Provide products suitable for piping service fluids, materials, working pressures, and temperatures.
2. Capability: Provide products and installations that will accommodate maximum axial movement as scheduled or indicated on Drawings.

B. Flexible-Hose Expansion Joints:
   a. Manufacturers: Metraflex (Metraloop), Mason Industries, Twin City Hose
   b. Source Limitations: Obtain flexible-hose packless expansion joints from single manufacturer.
   c. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend.
   d. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
   e. Expansion joints for steel piping: Sch40 steel end fittings and elbows, 300 series stainless steel hose and braid. 150 psi rated.
   f. Expansion joints for copper piping: copper end fittings and elbows, bronze hose and braid. 200 psi rated.

C. Alignment Guides and Anchors:

1. Anchor Clamps
   a. Manufacturer: Metraflex model PA
   b. Carbon steel with paint finish
   c. Provide felt dielectric shims for use with copper piping
   d. Anchor clamps to be used with “no-thrust” expansion joints only

2.2 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:
1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.

B. Sleeves with Waterstop:

1. Manufacturers: Metraflex, Flexicraft
2. Description: Manufactured galvanized-steel, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.

C. Sleeve-Seal Systems:
   1. Manufacturers: Metraflex, Flexicraft, Garlock
   2. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

      a. Hydrostatic Seal: 20 psig.
      b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
         1) Provide Nitrile links where hydrocarbons are present.
      c. Pressure Plates: Carbon steel
         1) Provide stainless steel plates where hydrocarbons are present.
      d. Connecting Bolts and Nuts: Carbon steel, with zinc coating. ASTM B633
         1) Provide stainless steel connectors where hydrocarbons are present.

D. Grout:

   1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
   2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
   3. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
   4. Packaging: Premixed and factory packaged.

2.3 ESCUTCHEONS

A. Escutcheons:
   1. Steel, with polished chrome finish

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS - GENERAL

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

3.3 INSTALLATION OF SLEEVES - GENERAL

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 in walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

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.

2. Using grout, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.4 INSTALLATION OF SLEEVES WITH WATERSTOP

A. Install sleeve with waterstop as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.

C. Secure nailing flanges to wooden concrete forms.

D. Using grout, seal space around outside of sleeves.

3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. 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.

3.6 INSTALLATION OF ESCUTCHEONS

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.

3.7 FIELD QUALITY CONTROL

A. Sleeves and Sleeve Seals:

1. Perform the following tests and inspections:

a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

2. Prepare test and inspection reports.

B. Escutcheons:

1. Using new materials, replace broken and damaged escutcheons and floor plates.

3.8 SLEEVES APPLICATION

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Sleeves with waterstops.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Sleeves with waterstops.

4. Interior Walls and Partitions:

a. Sleeves without waterstops.

3.9 ESCUTCHEONS APPLICATION

A. Escutcheons for New Piping and Relocated Existing Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Chrome-Plated Piping: One piece, steel with polished, chrome-plated finish.
3. Insulated Piping:

    a. One piece, steel with polished, chrome-plate finish.

4. Bare Piping at Wall and Floor Penetrations in Finished Spaces:

    a. One piece, steel with polished, chrome-plate finish.

5. Bare Piping at Ceiling Penetrations in Finished Spaces:

    a. One piece, steel with polished, chrome-plate finish.

B. Escutcheons for Existing Piping to Remain:

1. Insulated Piping: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.
5. Bare Piping in Equipment Rooms: Split plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: Split floor plate.
2. Existing Piping to Remain: Split floor plate.

3.10 DIELECTRIC FITTINGS APPLICATION

A. Provide dielectric fittings where dissimilar metals would otherwise be in contact.

END OF SECTION 230500

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC 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 NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C 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. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F

J. 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.

K. 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.

B. Motors Used with Variable Frequency Controllers/Drives:

1. Provide shaft grounding rings for all motors with VFDs.

2. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
3. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
4. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

5. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE ECM 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. Split phase.
   2. Capacitor start, inductor run.
   3. 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 230513

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SECTION 230519 - METERS AND GAGES 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. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

1.3 INFORMATIONAL 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. 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.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F .
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

a. Design for Air-Duct Installation: With ventilated shroud.
b. 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 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. 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.

2. Standard: ASME B40.100.

3. Case: 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, 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.
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.
12. Dial to be liquid filled.

2.3 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball, with NPS ¼ or NPS ½ , ASME B1.20.1 pipe threads.

2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
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. 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: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic self-sealing rubber.

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.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. 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.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

V. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-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 shall be the following:
1. Industrial-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages shall be the following:

1. Liquid-filled-direct mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range: 0 to 100 psi.

END OF SECTION 230519

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SECTION 230523 - 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. Bronze lift check valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron globe check 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.

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.

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, gate, 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 valve.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
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. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless Steel Ball and Stem:

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. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
g. Apollo

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.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 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. Crane Co.; Crane Valve Group; Jenkins Valves.
    b. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Tyco Valves & Controls; a unit of Tyco Flow Control.
    f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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: Aluminum bronze.

2.4 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.

2.5 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. Hammond Valve.
    d. Milwaukee Valve Company.
    e. NIBCO INC.
    f. Watts Regulator Co.; a division of Watts Water Technologies, 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.

2.6 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. Hammond Valve.
    c. Milwaukee Valve Company.
    d. NIBCO INC.
    e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
    c. NPS 14 to NPS 24, CWP Rating: 150 psig .
    d. Body Design: Clear or full waterway.
    e. Body Material: ASTM A 126, gray iron with bolted bonnet.
    f. Ends: Flanged.
    g. Trim: Bronze.
    h. Gasket: Asbestos free.

2.7 IRON GLOBE CHECK VALVES

A. Class 125, Iron Globe Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-125-2010
b. NPS 2-1/2 to NPS 14, CWP Rating: 125 psig.
c. Body Material: ASTM A 126, iron.
d. Seat, Plug, Spring, Bushing, Screw: ASTM T304, stainless steel

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.
1. Install shutoff valves on inlet and outlet sides of all major pieces of equipment such as boilers, chillers, etc.
2. Install shutoff valves at all branch takeoffs

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 chainwheels on operators for butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. 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.

B. Select valves, except wafer types, with the following end connections:
1. For Steel Piping, NPS 2 and Smaller: Threaded ends.
2. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Steel Piping, NPS 5 and Larger: Flanged ends.

C. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
2. Iron Swing Check Valves: Class 125, metal seats.

D. 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.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Ball Valves: Two piece, full port, bronze with stainless steel trim.
2. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 150 CWP, EPDM seat, aluminum-bronze disc.
2. Iron Globe Check Valves: Class 125.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Ball Valves: Two piece, full port, bronze with stainless steel trim.
2. Bronze Swing Check Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 150 CWP, EPDM seat, aluminum-bronze disc.
2. Iron Globe Check Valves: Class 125.

END OF SECTION 230523

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SECTION 230529 - 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. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. 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.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

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. Steel pipe hangers and supports.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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 trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel 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.

PART 2 - PRODUCTS

2.1 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. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.

8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

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.

2.2 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.

2.3 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: ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.

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.

2.4 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. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated- steel anchors, 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. 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.

2.5 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. 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.

B. 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/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

I. Install hangers and supports complete with necessary attachments, 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 that 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. 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 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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/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.

3.4 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.

C. 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. 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. 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.
4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.

F. 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.

G. 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.

H. 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.

I. 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.

J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

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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. Pipe labels.
3. Valve tags.

B. For each building hot water loop, building chilled water loop, and chiller water loop, provide a placard indicating the volume of water used to fill the system.

1.3 ACTION 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: Green.
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: 1/2 inch.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Snap on Pipe Labels: Printed plastic pre coiled for application without requiring adhesive or tape. Provide nylon ties for pipes 6” OD and larger and per pipe label manufacturer’s recommendations.

C. 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.

2.3 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 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.

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 Section 099123 "Interior Painting".

B. 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.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Condenser-Water Piping: White letters on an ANSI Z535.1 safety-green background.
3. Heating Water Piping: White letters on an ANSI Z535.1 safety-green background.
4. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.
5. Low-Pressure Steam Piping: Black letters on an ANSI Z535.1 safety-yellow background.
6. High-Pressure Steam Piping: Black letters on an ANSI Z535.1 safety-yellow background.
7. Steam Condensate Piping: Black letters on an ANSI Z535.1 safety-yellow background.
8. Gas: Black letters on an ANSI Z535.1 safety-yellow background.
9. Compressed Air: White letters on an ANSI Z535.1 safety-blue background

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

HVAC terminal devices 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. Condenser Water: 1-1/2 inches, round
   b. Refrigerant: 1-1/2 inches, round
   c. Hot Water: 1-1/2 inches, round
   d. Gas: 1-1/2 inches, round
   e. Low-Pressure Steam: 1-1/2 inches, round
   f. High-Pressure Steam: 1-1/2 inches, round
   g. Steam Condensate: 1-1/2 inches, round

2. Valve-Tag Color:

   a. Condenser Water: Natural
   b. Hot Water: Natural.
   c. Low-Pressure Steam: Natural
   d. High-Pressure Steam: Natural
   e. Gas: Yellow.

3. Letter Color:

   a. Condenser Water: Black
   b. Refrigerant: Black
   c. Hot Water: Black
   d. Gas: Black
   e. Low-Pressure Steam: Black
   f. High-Pressure Steam: Black
   g. Steam Condensate: Black

3.5 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 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Report Forms: Reports must be typewritten or computer generated – handwritten reports are not acceptable.

B. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:

    a. Constant-volume air systems.
    b. Variable-air-volume systems.
    c. Multizone systems.

2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:

    a. Constant-flow hydronic systems.
    b. Variable-flow hydronic systems.
    c. Primary-secondary hydronic systems.

3. Testing, adjusting, and balancing of fuel oil systems for HVAC.
4. Testing, adjusting, and balancing of equipment.
5. Testing, adjusting, and balancing of existing HVAC systems and equipment.
6. Procedures for exhaust hoods.
7. Sound tests.
8. Vibration tests.
9. Duct leakage tests verification.
10. Pipe leakage tests verification.
11. UFAD plenum leakage tests verification.
12. HVAC-control system verification.
13. Smoke-control system tests.

1.3 CONTRACTORS

A. Aero Building Solutions

B. International Test and Balance

C. Mechanical Test and Balance

1.4 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 independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.

1.5 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a remote TAB conference at after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 7 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.6 ACTION SUBMITTALS

A. Certified TAB reports.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 90 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 90days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 90 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 90 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. 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.

1.8 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.9 FIELD 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.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and 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 ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

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 verify that bearings are greased, belts are aligned and tight, filters are clean, 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 temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

L. Examine control valves for proper installation for their intended function of isolating, throttling, 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. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

Q. 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.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.

b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning in accordance with the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings 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. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
4. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with 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 units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Pumps.
3. Fans and ventilators.
4. Air curtains.
5. Terminal units.
6. Commercial kitchen hoods.
7. Boilers.

8. Deaerators.
9. Furnaces.
10. Radiant heaters.
11. Unit heaters.
12. Solar collectors.
13. Heat exchangers.
14. Condensing units.
15. Condensers.
16. Water chillers.
17. Cooling towers.
18. Energy-recovery units.
19. Air-handling units.
20. Heating and ventilating units.
21. Rooftop air-conditioning units.
22. Heating-only makeup air units.
23. Dedicated outdoor-air units.
24. Packaged air conditioners.
25. Self-contained air conditioners.
26. Computer-room air conditioners.
27. Split-system air conditioners.
28. Variable-refrigerant-flow systems.
29. Heat pumps.
30. Valance heating and cooling units.
31. Chilled beams.
32. Coils.
33. Fan coil units.
34. Unit ventilators.
35. Radiators.
36. Convectors.
37. Finned-tube radiation heaters.
38. Radiant-heating piping and] panels.
39. Humidifiers.
40. Dehumidification units.

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' Record drawings 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.

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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect 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.
5. 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 occurs. 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.

1. Measure airflow of submain and branch ducts.

2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

A. Adjust the dual-duct systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge. On systems with separate hot-deck and cold-deck fans, verify the location of the sensor on each deck.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point, 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.
4. Calibrate and balance each terminal unit's hot deck and cold deck for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for full cooling. Some controllers require starting with minimum set point. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factors as required for design cold-deck maximum airflow and hot-deck minimum airflow. Record calibration factors.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for full heating.
    e. Measure airflow and adjust calibration factors as required for design cold-deck minimum airflow and hot-deck maximum airflow. Record calibration factors. If no minimum calibration is available, note any deviation from design airflow.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity (cooling coil or fan), adjust terminals for maximum and minimum airflow so that connected total matches cooling coil or fan selection and simulates actual load in the building. In systems with separate hot-deck and cold-deck fans, diversity consideration applies to each individual fan.
    c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

6. Measure the fan(s) static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan(s) while operating at maximum return airflow and minimum outdoor airflow.

    a. Balance the return-air ducts and inlets.
    b. Verify that all terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:

    a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
    b. Re-measure and confirm that total airflow is within design.
    c. Re-measure final fan operating data, speed, volts, amps, and static profile.
    d. Mark final settings.
    e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
    f. Verify tracking between supply and return fans.

10. Record final fan-performance data.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point 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.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

6. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.

d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Balance the return-air ducts and inlets.
   b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:

   a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   b. Re-measure and confirm that total airflow is within design.
   c. Re-measure final fan operating data, speed, volts, amps, and static profile.
   d. Mark final settings.
   e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   f. Verify tracking between supply and return fans.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.

B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.

C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.

D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

   1. Measure total airflow.

      a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
      b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
      c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

   2. Measure fan static pressures as follows:

      a. Measure static pressure directly at the fan outlet or through the flexible connection.
      b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.
d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect 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.
5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

E. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

F. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlet and outlet airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

G. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.10 PROCEDURES FOR INDUCTION-UNIT SYSTEMS

A. Balance primary-air risers by measuring static pressure at the nozzles of the top and bottom units of each riser, to determine which risers must be throttled. Adjust risers to indicated airflow within specified tolerances.

B. Adjust each induction unit.

C. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Architect 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.
5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

D. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

E. Balance airflow to each induction unit by measuring the nozzle pressure and comparing it to the manufacturer's published data for nozzle pressure versus cfm. Adjust the unit's inlet damper to achieve the required nozzle pressure for design cfm.

F. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speeds, volts, amps, and static profile.

4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.11 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
5. Verify that motor controllers are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

1. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design flow.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gauge heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.13 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.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the pressure-differential sensor(s) is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no flow diversity:

1. Adjust pumps to deliver total design flow.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gauge heights.
        4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
        5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

    c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
c. Mark final settings.

D. For systems with flow diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by Architect.
3. Adjust pumps to deliver total design flow.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gauge heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to

achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    c. Mark final settings.

3.14 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design flow.

1. Measure total water flow.

    a. Position valves for full flow through coils.
    b. Measure flow by main flow meter, if installed.
    c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

2. Measure pump TDH as follows:

    a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
    b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
    c. Convert pressure to head and correct for differences in gauge heights.
    d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
    e. With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.15 PROCEDURES FOR STEAM AND CONDENSATE SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.

B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.

C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

D. Check settings and operation of each safety valve. Record settings.

E. Verify the operation of each steam trap.

3.16 PROCEDURES FOR STEAM-TO-WATER HEAT EXCHANGERS

A. Adjust and record water flow to within specified tolerances.

B. Measure and record inlet and outlet water temperatures.

C. Measure and record inlet steam pressure and condensate outlet pressure.

D. Check and record settings and operation of safety and relief valves.

3.17 PROCEDURES FOR WATER-TO-WATER HEAT EXCHANGERS

A. Adjust and record water flow to within specified tolerances.

B. Measure and record inlet and outlet water temperatures.

C. Measure and record pressure drop.

D. Check and record settings and operation of safety and relief valves.

3.18 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. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.19 PROCEDURES FOR WATER CHILLERS

A. Air-Cooled Chillers: Balance water flow through each evaporator to within specified tolerances of indicated flow, with all pumps operating. With only one chiller operating in a multiple-chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
5. Capacity: Calculate in [tons] [kilowatts] <Insert units> of cooling.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
7. Verify condenser-fan rotation and record fan and motor data, including number of fans and entering- and leaving-air temperatures.

B. Water-Cooled Chillers: Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow, with all pumps operating. With only one chiller operating in a multiple-chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. Condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in [tons] [kilowatts] <Insert units> of cooling.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.20 PROCEDURES FOR COOLING TOWERS

A. Closed-Circuit Cooling Towers: Balance total condenser-water flows to towers and cells. Measure and record the following data:

1. Condenser-water flow to each cell of the cooling tower.
2. Pressure drop through each cell.
3. Entering- and leaving-water temperatures.
4. Wet- and dry-bulb temperatures of entering air.
5. Wet- and dry-bulb temperatures of leaving air.
6. Barometric pressure, wind speed, and wind direction.
7. Condenser-water flow rate recirculating through the cooling tower.
8. Cooling-tower spray pump discharge pressure.
9. Condenser-water flow through bypass.
10. Makeup-water flow rate.
11. Makeup water temperature.
12. Fan, motor, and motor controller operating data.
13. Cooling-tower spray pump and motor operating data.
14. Heater operating data.

B. Open-Circuit Cooling Towers: Balance total condenser-water flows to towers and cells. Measure and record the following data:

1. Condenser-water flow to each cell of the cooling tower.
2. Pressure at each inlet connection.
3. Entering- and leaving-water temperatures.
4. Range.
5. Makeup-water flow rate.
6. Makeup water temperature.
7. Wet- and dry-bulb temperatures of entering air.
8. Wet- and dry-bulb temperatures of leaving air.
9. Approach.
10. Barometric pressure, wind speed, and wind direction.
11. Fan, motor, and motor controller operating data.
12. Heater operating data.

3.21 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

3.22 PROCEDURES FOR AIR-COOLED CONDENSERS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of fan(s) and motor(s).

3.23 PROCEDURES FOR BOILERS

A. Hydronic Boilers:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Fuel Consumption: If boiler fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

B. Steam Boilers:

1. Measure and record entering-water temperature.
2. Measure and record feedwater flow.
3. Measure and record leaving-steam pressure and temperature.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
7. Fan, motor, and motor controller operating data.

C. Boilers with Flue Gas Economizers:

1. Measure and record entering- and leaving-water temperature.
2. Measure and record water flow rate.
3. Measure and record water pressure drop.
4. Heat Recovered: Calculate in Btu/h of waste heat recovered.

3.24 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each hydronic 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. Air pressure drop.
5. Voltage and amperage input of each phase at full load.
6. Calculated kilowatt at full load.
7. 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. 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. Entering and leaving refrigerant pressure and temperatures.

3.25 PROCEDURES FOR EXHAUST HOODS

A. Room Pressure: Measure and record room pressure with respect to atmosphere and adjacent space with hoods in room initially not operating and then with hoods operating.

B. Makeup Air: Systems supplying source of makeup air to hoods shall be in operation during testing and balancing of exhaust hoods.

1. Measure and record temperature of makeup air entering hood. If hood makeup air is from multiple sources having different temperatures, measure and record the airflow and temperatures of each source and calculate the weighted average temperature.
2. Use simulated smoke to observe supply air-distribution air patterns in vicinity of hoods. Consult with hood manufacturer and report conditions that have a detrimental effect on intended capture, containment, and other attributes effecting proper operation.

C. Rooms with Multiple Hoods: Test each hood separately, one at a time, and repeat tests with all hoods intended to operate simultaneously by design.

D. Canopy Hoods: Measure and record the following:

1. Pressure drop across hood.
2. Airflow by duct traverse where duct distribution will allow accurate measurement, and calculate hood average face velocity.
3. Measure velocity across hood face and calculate hood airflow.

    a. Clearly indicate the direction of flow at each point of measurement.

b. Measure velocity across opening on not less than 12-inch centers. Record velocity at each measurement, and calculate average velocity.

4. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

E. Laboratory Fume Hoods: Measure and record the following:

1. Pressure drop across hood.
2. Airflow by duct traverse where duct distribution will allow accurate measurement, and calculate hood average face velocity. If hood is connected to exhaust duct distribution through an exhaust device with integral airflow measurement, that reading may be used in lieu of a duct traverse.
3. Face velocity across open hood face and calculate hood airflow.

a. Clearly indicate the direction of flow at each point of measurement.
b. Measure velocity across opening on not less than 6-inch centers. Record velocity at each measurement, and calculate average velocity.

4. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.
5. ASHRAE 110 Testing: With room and laboratory fume hood operating at design conditions, perform an "as-installed" performance test of the laboratory fume hood in accordance with ASHRAE 110. Test [each] [indicate extent] laboratory fume hood and document the test results.

F. Kitchen Hoods:

1. Type 1: Measure and record pressure drop and face velocity of hood filters and slots in accordance with hood manufacturer's instructions. Consult hood manufacturer to determine hood airflow using recorded information.
2. Type 2: Measure and record airflow by duct traverse.
3. Capture and Containment: Check each hood for proper capture and containment using a smoke-emitting device. Observe and report performance. Make adjustments to achieve optimum results.

G. AHJ Tests: Conduct additional tests required by authorities having jurisdiction.

3.26 SOUND TESTS

A. After systems are balanced and Substantial Completion, measure and record sound levels at 10 locations as designated by the Architect.

B. Instrumentation:

1. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.

2. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (L_{eq}).
3. The sound-testing meter must be capable of using one-third octave band filters to measure mid-frequencies from 31.5 Hz to 8000 Hz.
4. The accuracy of the sound-testing meter shall be plus or minus one decibel.

C. Test Procedures:

1. Perform test at quietest background noise period. Note cause of unpreventable sound that affects test outcome.
2. Equipment should be operating at design values.
3. Calibrate the sound-testing meter prior to taking measurements.
4. Use a microphone suitable for the type of noise levels measured that is compatible with meter. Provide a windshield for outside or in-duct measurements.
5. Record a set of background measurements in dBA and sound pressure levels in the eight unweighted octave bands 63 Hz to 8000 Hz with the equipment off.
6. Take sound readings in dBA and sound pressure levels in the eight unweighted octave bands 63 Hz to 8000 Hz with the equipment operating.
7. Take readings no closer than 36 inches from a wall or from the operating equipment and approximately 60 inches from the floor, with the meter held or mounted on a tripod.
8. For outdoor measurements, move sound-testing meter slowly and scan area that has the most exposure to noise source being tested. Use A-weighted scale for this type of reading.

D. Reporting:

1. Report shall record the following:

a. Location.
b. System tested.
c. dBA reading.
d. Sound pressure level in each octave band with equipment on and off.

2. Plot sound pressure levels on Noise Criteria worksheet with equipment on and off.

3.27 VIBRATION TESTS

A. After systems are balanced and Substantially Completion, measure and record vibration levels on equipment having motor horsepower equal to or greater than 10.

B. Instrumentation:

1. Use portable, battery-operated, and microprocessor-controlled vibration meter with or without a built-in printer.
2. The meter shall automatically identify engineering units, filter bandwidth, amplitude, and frequency scale values.
3. The meter shall be able to measure machine vibration displacement in mils of deflection, velocity in inches per second, and acceleration in inches per second squared.
4. Verify calibration date is current for vibration meter before taking readings.

C. Test Procedures:

1. To ensure accurate readings, verify that accelerometer has a clean, flat surface and is mounted properly.
2. With the unit running, set up vibration meter in a safe, secure location. Connect transducer to meter with proper cables. Hold magnetic tip of transducer on top of the bearing, and measure unit in mils of deflection. Record measurement, then move transducer to the side of the bearing and record in mils of deflection. Record an axial reading in mils of deflection by holding nonmagnetic, pointed transducer tip on end of shaft.
3. Change vibration meter to velocity (inches per second) measurements. Repeat and record above measurements.
4. Record CPM or rpm.
5. Read each bearing on motor, fan, and pump as required. Track and record vibration levels from rotating component through casing to base.

D. Reporting:

1. Report shall record location and the system tested.
2. Include horizontal-vertical-axial measurements for tests.
3. Verify that vibration limits follow Specifications, or, if not specified, follow the General Machinery Vibration Severity Chart or Vibration Acceleration General Severity Chart from AABC's "National Standards for Total System Balance." Acceptable levels of vibration are normally "smooth" to "good."
4. Include in General Machinery Vibration Severity Chart, with conditions plotted.

3.28 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.29 PIPE LEAKAGE TESTS

A. Witness the pipe pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.30 UFAD PLENUM LEAKAGE TESTS

A. Witness the UFAD plenum pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.31 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.32 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
4. Check the refrigerant charge.
5. Check the condition of filters.
6. Check the condition of coils.
7. Check the operation of the drain pan and condensate-drain trap.
8. Check bearings and other lubricated parts for proper lubrication.
9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates and water flow rates by more than [5] <Insert number> percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is [5] <Insert number> percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.33 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
3. Heating-Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.
4. Chilled-Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm , within 10 percent.
5. Condenser-Water Flow Rate: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.34 PROGRESS 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 system-balancing devices. Recommend changes and additions to system-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 monthly progress reports 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.

3.35 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.
3. Certify validity and accuracy of field data.

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 specialist.
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 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. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.

g. [Variable-frequency controller] [Inlet vane] settings for variable-air-volume systems.
h. Settings for pressure controller(s).
i. Other system operating conditions that affect performance.

16. Test conditions for pump performance forms, including the following:

a. Variable-frequency controller settings for variable-flow hydronic systems.
b. Settings for pressure controller(s).
c. 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, 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 speed.
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 airflow rate in cfm.
b. Total system static pressure in inches wg.

c. Fan speed.
d. Inlet and discharge static pressure in inches wg.
e. For each filter bank, 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. List for each internal component with pressure-drop, static-pressure differential in inches wg.
j. Outdoor airflow in cfm.
k. Return airflow in cfm.
l. Outdoor-air damper position.
m. Return-air 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. Airflow 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 speed.
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 airflow 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. Airflow 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. Airflow 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 speed.
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 (mm).
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 speed.
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 fan 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 airflow rate in cfm.

h. Indicated velocity in fpm.
i. Actual airflow 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. (sq. m).

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow 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. Airflow 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 speed.
    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.

3.36 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.

B. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. 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."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall 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. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.37 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.

C. Perform additional tests at the direction of the Commissioning Agent.

END OF SECTION 230593

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OCTOBER 2026

SECTION 230700 – HVAC 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:

1. Insulation Materials:

    a. Flexible elastomeric.
    b. Mineral fiber.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.
10. Corner angles.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.4 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

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.
8. Detail field application for each equipment type.

B. Qualification Data: For qualified Installer.

C. 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.

D. 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting 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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

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 Part 3 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. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. 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 I 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.; Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Duct Wrap.
    d. Manson Insulation Inc.; Alley Wrap.
    e. Owens Corning; All-Service Duct Wrap.

F. 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. For equipment 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.

G. 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 Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas Pipe Insulation.

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.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide the following:

    a. Aeroflex USA Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA

2. Elastomeric insulation for exterior use: Armacell Armaflex with Alumaguard jacket.

2.2 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. 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 Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); 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; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-35.
    b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    c. ITW TACC, Division of Illinois Tool Works; CB-50.
    d. Marathon Industries, Inc.; 590.
    e. Mon-Eco Industries, Inc.; 55-40.
    f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 permat 43-mildry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 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 Products, Division of ITW; CP-10.

b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 permsat 0.0625-inchdry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.4 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: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.5 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 PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: 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.

5. Factory-fabricated tank heads and tank side panels.

2.6 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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
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. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. 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/inchin width.

2.7 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed 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, 0.106-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.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment 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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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 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: Install insulation continuously through penetrations of fire-rated walls and partitions. 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 Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. 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. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "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 and polyolefin, 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, vessels, and equipment. 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 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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 MINERAL-FIBER INSULATION INSTALLATION

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 but 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.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inchoverlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation: (refer to duct insulation schedule on plans for project specific information)

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.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.
13. Combustion air.

14. Ducts or plenums where the temperature difference between the interior and exterior of the duct of plenum is greater than 15F
15. Duct installed on the exterior of the building. Insulate with R12 polyisocyanurate and cover with AlumaGuard jacket unless noted otherwise on plans.

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.

3.10 DUCT INSULATION SCHEDULE

A. Refer to plans for duct insulation schedule.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Refer to plans for piping insulation schedule.

END OF SECTION 230700

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SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.7 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Subcontractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R systems, subsystems, and equipment Testing Procedures

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas and hot-water systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

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OCTOBER 2026

SECTION 230900 – INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

A. Extend the existing Trane Tracer BAS and Ensemble Server to include the equipment installed as part of this project. Provide floorplan graphics and equipment graphics to match EASD standards. All major pieces of equipment are to be visible on the BAS and have their own equipment graphic. Update chiller plant graphic per information on mechanical plans.

B. Temperature controls contractor to conduct BAS review sessions with design engineer via Microsoft Teams to review and adjust sequences, setpoints, and graphics.

C. Provide new control valves for all existing hydronic equipment with their associated sensors.

PART 2 - PRODUCTS

2.0 SECTION INCLUDES

2.1 BAS ARCHITECTURE/COMMUNICATION

2.2 OPERATOR INTERFACE

2.3 BAS SOFTWARE MINIMUM CAPABILITIES

2.4 ACCEPTABLE MANUFACTURERS AND INSTALLING CONTRACTORS

2.5 SYSTEM CONTROLLER

2.6 CUSTOM APPLICATION CONTROLLERS

2.7 APPLICATION SPECIFIC CONTROLLERS

2.1 BAS ARCHITECTURE/COMMUNICATION

A. System Controller: The building automation system (BAS) shall consist of an HTML5 web-based System Controller or Controllers, communicating over the customer IP network to each other and to Operator Workstations via BACnet IP.

1. Each System Controller shall communicate to a network of Custom Application and Application Specific Controllers using BACnet MSTP as prescribed by the BACnet standard.

2. Each System Controller shall function as a BACnet Router to all unit controllers providing all BACnet MSTP points as fully open and fully exposed, read/write capable, BACnet IP points to any higher level Enterprise BAS system or any 3rd party BACnet-capable BAS system.

3. System Controllers and any required Servers or Server Software must be BTL Listed to ensure open protocol compatibility.

4. Licensing. Provide all System Controllers and Servers with the following licensing, and all associated necessary hardware for each protocol, to ensure future compatibility and system expandability independent of the original installing contractor of the BAS:

    a. BACnet MSTP (ASHRAE BACnet Standard, Data Link Layer – MS/TP Master Clause 9)
    b. LonTalk (ASHRAE BACnet Standard, Data Link Layer – Clause 11)
    c. BACnet IP (ASHRAE BACnet Standard, Data Link Layer - Annex J)
    d. BACnet/ZigBee (ASHRAE BACnet Standard, Data Link Layer - Annex O)
    e. Modbus RTU
    f. Modbus TCP/IP

B. Custom Application and Application Specific Unit Controllers shall meet the following communication requirements:

1. Communicate to System Controller via BACnet MSTP

2. To allow maximum communications speed and co-existence with other controllers, the controller shall support at a minimum the following BACnet MSTP master baud rates: 9600, 19200, 38400, 76800, and 115200.

3. To ensure compatibility to other BACnet systems the controller must be BTL Listed as:
    a. Advance Applications Controller (B-AAC) for Custom Application Controllers
    b. Application Specific Controller (B-ASC) and Supports sending alarm/event notifications to a subscriber, for Application Specific Controllers

C. Wireless Custom Application and Application Specific Unit Controllers and Auxiliary Wireless Control devices shall conform to:

1. IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and signal range.

2. Operating range shall be a minimum of 200 feet; open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.

3. Installation and replacement of failed sensors shall be accomplished automatically after power up of the failed device or power up of the properly addressed replacement device.

4. Wireless communication shall be ASHRAE BACnet MSTP over ZigBee (Annex O).

5. Wireless temperature, humidity and occupancy sensors shall be “maintenance-free” type and have a published battery life of no less than 15 years under typical operating range conditions as described above (10 years for wireless CO2 sensors).

6. Wireless temperature, humidity, occupancy and CO2 sensors shall utilize IEEE 802.15.4 radios and shall be a part of the ZigBee mesh network.

7. To ensure future compatibility to other BACnet systems each controller must be BTL Listed and Tested.

2.2 OPERATOR INTERFACE

A. The System Controller shall provide an embedded web-interface for end-user access to the building automation system (BAS). BAS web-interface shall be HTML5 to ensure universal browser compatibility including PC’s, laptop’s, tablets and mobile phones. JAVA-based web-interfaces are not compatible with standard iOS and Android devices and are not acceptable. Systems using Launcher programs that must be installed on a user’s PC or mobile device are not acceptable.

B. No dedicated PC workstation shall be required, as any current-version PC, laptop, tablet or mobile phone shall be capable of accessing the BAS. At a minimum the BAS web-interface shall be compatible with the following operating systems and browsers:

1. Operating Systems:
   a. Windows 7, Windows 8, Windows 8.1, Windows 10
   b. MAC OS X 10.8 (Mountain Lion), 10.9 (Mavericks), 10.10 (Yosemite)
   c. iOS (iPad/iPhone) V4.0+
   d. Android (Tablet/Phone) V4.0+

2. Web Browsers:
   1) Internet Explorer 8.0+
   2) Firefox 4.0+
   3) Chrome 10.0+
   4) Safari (iOS) V4.0+
   5) Android Chrome V4.0+

C. Mobile Device Application (“App”): Provide to the owner as part of this project the corresponding mobile device and tablet application (“App”) for the BAS System. All licensing and subscription costs for the application shall be included for 5 years and no fewer than five (5) individual licenses on both Android and Apple (iOS) devices. The Owner shall incur no cost to use the mobile device and tablet Application(s) for the 5 year period starting with Owner acceptance.

D. Operator Displays: Provide color touchscreen operator displays for all Custom Application controllers including any central plant systems (HW, CHW, CW) and Air Handling Units (AHU's). Provide same animated BAS graphic viewable at the BAS for viewing on each operator display.

E. Secure VPN Access: Provide all hardware (e.g. routers) and software required for customer access to the BAS remotely from any device via a secure VPN connection into the customer IP network.

2.3 BAS SOFTWARE MINIMUM REQUIREMENTS

1. System Security
   a. Each operator shall be required to login to the system with a user name and password in order to view, edit, add, or delete data.
   b. User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.
   c. Each operator shall be allowed to change their user password.
   d. The System Administrator shall be able to manage the security for all other users including configurable adherence to the following password rules: Minimum number of characters, mixed case required, number required, symbol required, password expiration, number of previous passwords blocked from reuse and password shall not contain user info.
   e. User logon/logoff attempts shall be recorded and automatic logoff after inactivity provided.

2. On-Line Help and Training
   a. Provide a context sensitive, on-line help system to assist the operator in operation of the system including screenshot demonstrations of changing setpoints and schedules
   b. Provide on-line owner training video for typical daily operator tasks
   c. Provide PDF Installation & Setup Manual and PDF User Guide (Daily Operator Guide)

3. Equipment Graphics: HVAC equipment graphics shall be 3D photo-realistic animated type with animated fans, dampers and coils. Links shall be available from each graphic page to view all equipment data points, setpoints and equipment trend logs.

4. System Graphics: HVAC systems shall have custom 3D flow-based animated graphics created and loaded into the BAS for each system, including HW, CHW and Condenser water systems. Links shall be available from each graphic page to view all system data points, setpoints and system trend logs.

5. Manual Point Control and Override.
   a. Point Control: Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
   b. Temporary (Expiring) Overrides: The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.

c. Provide a specific visual indication icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
d. Provide an "All Points In Override" report at the BAS Reports menu to allow the end user to easily identify all of the overrides that exist in the system.

6. Scheduling. An everyday user shall be able to perform the following tasks at the BAS:
   a. Create a new schedule, defining the default values, events and membership.
   b. Create exceptions to a schedule for any given day.
   c. Apply an exception that spans a single day or multiple days.
   d. View a schedule by day, week and month.
   e. Exception schedules and holidays shall be shown clearly on the calendar.
   f. Modify the schedule events, members and exceptions.
   g. Create Optimal Start/Stop schedules, define an early start limit, utilize outdoor air temperature compensation, and show current active heating and cooling rates (min/deg).

7. Trend Logs
   a. Trend Log Creation. The daily user shall be able to create and define a trend log for any point available in the BAS.
   b. Trend Log Viewing.
      1) The operator interface shall allow Trend Log data to be viewed in a tabular or graphical format, printed, and exported to a PDF or Excel file at a minimum.
      2) Trend log viewing including the capability to show a minimum of 5 points on a chart with each displayed in a unique color and with data values shown upon mouse-over.
   c. Trend Log Capacity. Provide a minimum capacity of 3 years of trend data storage at 15-minute sampling interval for a minimum of 10 points per controller in the system. Provide a minimum capacity of 125,000 samples per data point.
   d. Trend Log Setup. BAS contractor shall setup at a minimum 90-days of trend logs sampled at 15 minute interval for every Space Temperature and Space Setpoint value in the system.

8. Alarm/Event Notification
   a. An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.
   b. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any operator interface.
      1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
      2) Alarm/Event Log shall be capable of storing the last 1000 alarms/events indefinitely
      3) An operator with the proper security level may acknowledge and clear alarms/events.
      4) The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.
   c. Email Alarming. Alarms shall be capable of being emailed out to various recipients at varying severity levels, along with cascading email alarms when critical alarms are not acknowledged in a timely manner.

d. Alarm Scheduling. Alarms shall be schedulable so as to be sent to different recipients/locations based on the time of day and the day of the week.
e. Audible Alarm Notification. Provide an audible notification upon receiving alarms/events that is customizable per user-preference and alarm severity.

9. Reports
   a. The BAS shall allow a user to export reports in PDF or Excel formats at a minimum.
   b. Define and provide the following points to all users of the BAS:
      1) All Points in Alarm Report: Provide an on demand report showing all current alarms.
      2) All Points in Override Report: Provide an on demand report showing all overrides.
      3) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation including current point data and setpoints.
      4) BACnet Objects Report: Provide a report that lists each BACnet Object in the system.

10. Standard BAS Routines and Programming
    a. VAV System Coordination. Provide programming necessary to ensure equipment safety and minimize energy usage, including:
       1) Startup and shutdown the air handler safely. Ensure the VAV boxes are open sufficiently when the equipment is running, to prevent damage to the ductwork and VAV boxes due to high air pressure.
       2) Ensure minimum air flows for gas and electric heating applications.
       3) Automatically scheduled calibration of the VAV boxes.
       4) Static Pressure Optimization Routine (Per ASHRAE 90.1-2013)
       5) Area-Based Scheduling Control. Provide multiple time of day schedules for each Area of VAV zones with different scheduling needs and shut unoccupied VAV box dampers to provide fan horsepower energy savings.
       6) Timed Override. Provide functionality and programming to allow building occupants to override the VAV system to the occupied mode for a user-definable time period.
       7) Changeover-Bypass System Zone Voting Logic. Provide Changeover zone voting logic with heat/cool callers, strong heat/cool callers and voting enabled/disabled functionality to control individual zones in RTU/AHU changeover systems with static pressure controlled bypass dampers.

11. Custom 3D Floorplan Graphics
    a. Contractor shall create and provide or shall consult a graphics design contractor (e.g. QA Graphics, www.qagraphics.com, www.bascustomgraphics.com or equal) and provide custom 3D floorplan graphics with extruded 3D walls, showing supply ductwork and showing terminal equipment locations.

b. Provide no more than 15 devices/controllers/space sensors per 3D graphic page. Provide additional graphic pages partitioned as necessary to maintain 15 or less devices/controllers/space sensors per 3D graphic page.
c. Provide overall mini-map graphic on each floorplan graphic page showing building partitions and provide hyperlinks to each individual graphic page from the mini-map.
d. Provide hyperlinks on all equipment and temperature readings linking directly to the equipment graphic page.
e. OPTIONAL: Provide 3D Thermal Floorplan Graphics with background images for each individual zone that change color based on the temperature in the zone. Provide a minimum of 3 colors per zone to indicate Normal, Warm/Hot, and Cool/Cold.

12. Custom HTML5 Widget Graphics
    a. System shall be provided with the capability to embed content from external websites onto custom HTML5 graphic pages including weather widgets from sites such as accuweather.com or Forecast.io

13. Adding Future or Replacing Existing BACnet IP/MSTP/ZigBee or LonTalk controllers
    a. System shall be provided with all software, plugins, licensing and add-on service tools to allow the owner or any future servicing contractor to add up to 5 additional unit controllers to the system using only the HTML5 web user interface
    b. System software shall include search/discover functionality for new devices for each type of communication (BACnet IP, BACnet MS/TP, BACnet ZigBee, LonTalk)
    c. System shall allow the user to add the new devices to the BAS and setup time of day schedules, provide 3D animated graphic, setup data logs, route alarms and change setpoints all without requiring involvement from the original installing BAS contractor.

2.4 ACCEPTABLE MANUFACTURERS AND INSTALLING CONTRACTORS

A. Trane Tracer SC+ by Trane, Willowbrook, IL
B. Control valves: stainless steel ball and stem, Belimo. All control valves to be ball valves unless noted otherwise on plans.
C. Actuators: Belimo, 24V unless noted otherwise on plans. Actuators to be modulating unless noted otherwise on plans.

2.5 SYSTEM CONTROLLERS AND ENTERPRISE SOFTWARE

A. There shall be one or more independent microprocessor-based System Controllers to contain and provide the BAS Software Minimum Capabilities as previously described.

    1. The System Controller shall have sufficient memory to support its operating system, database, and programming requirements.

2. The controller shall provide a USB communications port for direct connection to a PC or laptop.

3. All System Controllers shall have a real time clock.

4. Environment. Controller hardware shall be suitable for the anticipated ambient conditions. Controller shall be mounted in a NEMA-1 enclosure at a minimum, and shall be rated for operation at -40°C to 50°C [-40°F to 122°F].

5. Clock Synchronization.

    a. All System Controllers shall be able to synchronize with a NTP server for automatic time synchronization.

    b. All System Controllers shall be able to accept a BACnet time synchronization command for automatic time synchronization.

    c. All System Controllers shall automatically adjust for daylight savings time if applicable.

6. Serviceability

    a. Provide diagnostic LEDs for power, communications, and processor.

7. Memory. The System Controller shall maintain all BIOS and programming information indefinitely without power to the System Controller

8. Immunity to power and noise. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shut-down below 80% nominal voltage

9. BACnet Testing Labs (BTL) Listing. Each System Controller shall be listed as a BACnet Building Controller (B-BC) by BACnet Testing Labs.

2.6 ENTERPRISE SOFTWARE INTEGRATION WITH CONTROLS SYSTEMS

A. New building controls hardware (Tracer SC+) provided as part of this project must integrate to existing School District enterprise level building automation software. Existing enterprise system is Trane Tracer Ensemble. New controls hardware will communicate to Tracer Ensemble via BACnet/IP communication on the school district local area network. Control points and values available in the building level controller will be communicated to the enterprise software and be available for all data logging, trending, analysis, and graphical display content as required.

B. Acceptable Manufacturers:

Trane Tracer Ensemble as installed by local Trane Chicago local office: BACnet Advanced Operator Workstation - BTL Listed

2.7 ENTERPRISE SOFTWARE INTEGRATION WITH OTHER SYSTEMS

A. The enterprise software, Tracer Ensemble, described above in Section 2.6 (Enterprise Software Integration with Controls Systems) will be able to integrate with the Microsoft Active Directory account of the owner. The usernames and passwords of the business enterprise accounts will become the primary access credentials for the Building Automation System. The User ID and Password criteria will be user specific and will be updated when there is a change to the Microsoft Active Directory accounts. The usernames and passwords on the Microsoft Active Directory will be user specific after integration into the BAS software so to allow for varying levels of user access to occur based on the person accessing the system.
   1. Owner will provide a list of empoyees that should have access to each building control system and individual control system pages. The controls contractor shall reflect those parameters during the programming of the enterprise software.
   2. The owner will provide a list of employees that should have access to all systems and all buildings.
   3. The owner will provide a list of employees that should be system “admins” which will allow for the creation of new user accounts and any major system changes required.

2.8 CUSTOM APPLICATION CONTROLLERS

A. Description. Custom Application Controllers are controllers that operate Applied Air-handling Units (AHU’s), Central Chilled Water, Condenser Water, Steam and Hot Water Systems and are fully programmable for each application, per the sequence of operation.

B. Custom Application Controller Hardware and Software Requirements

   1. Scheduling. The Controller shall have a built in schedule using a Real Time Clock with a 7 day power backup and shall be capable of operating standalone from its local operator display

   2. Trend Logs. For ease of troubleshooting, the Controller shall support data trend logging

      a. Trends shall be capable of being collected at a minimum sample rate of once every second with a minimum total capacity of 25,000 samples.

      b. Trends shall be capable of being viewed from the BAS or the local operator display

3. Licensing. Controllers with individual licenses available from the manufacturer, with varying degrees of features available to the owner, shall be provided with the license providing the most feature-rich controller. Licensing that restricts the feature set available to the owner shall not be acceptable.

4. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

    a. Storage conditions:

        1) Temperature: -67°F to 203°F (-55°C to 95°C)

        2) Humidity: Between 5% to 100% RH (non-condensing)

    b. Operating conditions:

        1) Temperature: -40°F to 158°F (-40°C to 70°C)

        2) Humidity: Between 5% to 100% RH (non-condensing)

    c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum

    d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40°F to 158°F [-40°C to 70°C].

5. Inputs/Outputs: The Controller shall have on-board or expansion I/O capable of performing all functionality needed for the application, including:

    a. Shall support flexibility in actuator type, the controllers shall be capable of supporting the following actuator control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC - 2 position.

    b. Shall support flexibility in sensor type, the Controller shall be of reading sensor input ranges of 0 to10V, 0 to 20mA, 50ms or longer pulses, 200 to 20Kohm and RTD input.

    c. Shall support flexibility in sensor type, the Controller and/or expansion modules shall support dry and wetted (24VAC) binary inputs.

    d. The controller support pulse accumulator for connecting devices like energy meters.

    e. In order to support a wide range of devices, the Controller’s binary output shall be able to drive at least 10VA each.

    f. Spare I/O. Any Spare I/O that is unused by functionality needed for the equipment shall be available to be used by custom programming on the Controller and by the BAS.

g. The Controller shall provide 24VAC and 24VDC power terminals.

h. Controller shall be capable of expanding to at least 100 hardware I/O terminations.

6. Serviceability – The Controller shall provide the following to improve serviceability.

a. Diagnostic LEDs for power/normal operation/status, BACnet communications, sensor bus communications, and binary outputs. All wiring connections shall be clearly labeled and made to be field removable.

b. Software service tool connection through all of the following methods: direct USB cable connection to the Controller, USB connection through another controller on the BACnet link and through USB connection to the System Controller.

c. Programming and testing of controller programs must, for safety purposes, be initially able to be accomplished with the power off to the equipment and to the controller.

d. Capabilities to temporarily override the BACnet point values with time-expiring overrides.

7. Software Retention: All Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

8. Controller must meet the following Agency Compliance:

a. UL916 PAZX, Open Energy Management Equipment
b. UL94-5V, Flammability
c. FCC Part 15, Subpart B, Class B Limit
d. BACnet Testing Laboratory (BTL) Listed
e. cUL and CE Marked for international compliance

2.9 APPLICATION SPECIFIC CONTROLLERS

A. Description. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which through hardware and firmware design control specified equipment. They are not typically user- programmed, but are configurable for operation within the confines of the equipment they are designed to serve (e.g. VAV's, Fan Coils, Cabinet Unit Heaters, Blower Coils, Unit Ventilators, Heat Pumps, Chilled Beams, and Water Source Heat Pumps).

B. Application Specific Controller Hardware and Software Requirements.

1. Enclosures. All Application Specific Controllers not installed within the equipment being controlled shall be provided with and installed in a NEMA-1 rated metal enclosure at a

minimum. All VAV controllers and VAV damper actuators shall be installed in and protected from dirt and dust by a NEMA-1 metal enclosure.

2. Software. To meet the sequence of operation for each equipment type the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or field-downloaded with a service tool into the controller. Controller shall be capable of being fully field programmed to accomplish custom sequences of operation and/or utilize Spare I/O.

3. Licensing. Controllers with individual licenses available from the manufacturer, with varying degrees of features available to the owner, shall be provided with the license providing the most feature-rich controller. Licensing that restricts the feature set available to the owner shall not be acceptable.

4. Stand-Alone Operation: Each piece of equipment shall be controlled by a single DDC controller and provide stand-alone control in the event of a communications failure, utilizing last known communicated values and/or comm-fail values.

5. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.
   a. Storage: -55 to 203ºF (-48 to 95ºC) and 5 to 95% RH (non-condensing).
   b. Operating: -40 to 158ºF (-40 to 70ºC) and 5 to 95% RH (non-condensing).
   c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum
   d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40ºF to 158ºF [-40ºC to 70ºC].

6. Inputs/Outputs:

   a. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally or Normally Closed).
   b. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
   c. For flexibility in selection and replacement of binary sensors, the controller shall support dry and wetted (24VAC) binary inputs.
   d. For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.
   e. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
   f. Spare I/O. Any Spare I/O that is unused by functionality needed for the equipment shall be available to be used by custom programming on the Controller and by the BAS.
   g. Expandability. For future expandability needs controller shall be capable of expanding to at least 50 hardware I/O terminations.

7. Serviceability – The controller shall provide the following to improve serviceability.

a. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
b. All binary output shall have LED's indicating the output state.
c. Software service tool connection through all of the following methods: direct USB cable connection to the Controller, USB connection through another controller on the BACnet link and through USB connection to the System Controller.
d. For safety purposes, the controller shall be capable of being powered by a portable computer USB cable for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
e. Capabilities to temporarily override BACnet point values with expiring overrides.
f. BACnet trending objects resident on controller
    1) Shall be capable of trending all BACnet points used by controller
    2) Minimum of 20,000 trending points total on controller
    3) Shall be capable of 1 second sample rates on all points

8. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.

9. Agency Approval: The controller shall have met the following Agency Compliance:
    a. UL916 PAZX, Open Energy Management Equipment
    b. UL94-5V, Flammability
    c. FCC Part 15, Subpart B, Class B Limit
    d. BACnet Testing Laboratory (BTL) Listed
    e. cUL and CE Marked for international compliance

PART 3 - EXECUTION

3.0 SECTION INCLUDES

3.1 COORDINATION

3.2 GENERAL WORKMANSHIP

3.3 FIELD QUALITY CONTROL

3.4 WIRING

3.5 COMMUNICATION WIRING

3.6 INSTALLATION OF SENSORS

3.7 IDENTIFICATION OF HARDWARE AND WIRING

3.8 CONTROL SYSTEM CHECKOUT AND TESTING

3.9 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

3.10 CLEANING

3.11 TRAINING

3.12 WARRANTY REQUIREMENTS

3.1 COORDINATION

A. Test and Balance

1. The contractor shall furnish two sets of all software and hardware tools necessary to interface to the control system and each individual unit controller for test and balance purposes.

2. The contractor shall provide training in the use of these tools. In addition, the contractor shall provide a qualified controls programmer to assist in the test and balance process for a minimum duration of 8 hours.

3.2 GENERAL WORKMANSHIP

A. Install equipment, piping, wiring/conduit, parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible locations as defined by National Electric Code (NEC). Control panels shall be attached to structural walls or properly supported in a free-standing configuration, unless mounted in equipment enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

D. Verify integrity of all control wiring to ensure continuity and freedom from shorts and grounds prior to commencing the startup and commissioning procedures.

E. All control device installation and wiring shall comply with Contract Documents, acceptable industry specifications, and industry standards for performance, reliability, and compatibility. Installation and wiring shall be executed in strict adherence to local codes and standard practices referenced in Contract Documents.

3.3 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Contract Documents.

B. BAS manufacturer shall continually monitor the field installation for building code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. BAS installing Contractor(s) shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.4 WIRING

A. All control and interlock wiring shall comply with the National, Local Electrical Codes, and Section 260000 of these Contract Document specifications. Where the requirements of this section differ with those in Section 260000, the requirements of this section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway according to NEC requirements.

C. Where Class 2 wires are in concealed and accessible locations; including ceiling return air plenums, approved cables outside of electrical raceway can be used provided that the following conditions are met:

D. Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

E. All cables shall be UL listed for application (i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose).

F. Do not install Class 2 wiring in conduits containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two via control relays and transformers.

G. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

H. Maximum allowable voltage for control wiring shall be 120Vac. If only higher voltages are available for use, the BAS manufacturer shall provide step-down transformers to achieve the desired control voltages.

I. All control wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

J. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with Contract Documents and National and/or Local Codes.

K. Conduit and wire sizing shall be determined by the BAS manufacturer in order to maintain manufacturer’s recommendation and meet National and Local Codes.

L. Control and status relays are to be located in pre-fabricated enclosures that meet the application. These relays may also be located within packaged equipment control panel enclosures as coordinated. These relays shall not be located within Class 1 starter enclosures.

M. Follow manufacturer's installation recommendations for all communication and network bus cabling. Network or communication cabling shall be run separately from all control power wiring.

N. BAS manufacturer shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

O. Flexible metal conduits and liquid-tight flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.5 COMMUNICATION WIRING

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer’s installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer shall not be exceeded during installation.

D. Contractor shall verify the integrity of the entire network following cable installation. Use appropriate test measures for each particular cable.

E. When a cable enters or exits a building, a lighting arrestor must be installed between the line and ground.

F. All runs of communication wiring shall be unspliced length when the length is commercially available.

G. All communication wiring shall be labeled to indicate origin and destination.

3.6 INSTALLATION OF SENSORS

A. Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations.

B. Sensors that require field mounting shall meet the BAS manufacturer's recommendations and be coordinated with the mechanical equipment they will be associated

C. Mount sensors rigidly and adequately for the environment the sensor will operate

D. Wired room temperature sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed and must meet applicable National and Local Electrical Codes.

E. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings.

F. Install duct static pressure tap with tube end facing directly down-stream of air flow.

G. Install space static pressure sensor with static sensing probe applicable for space installation where applicable.

H. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

I. All pipe mounted temperature sensors shall be installed in matched thermowells. Install all liquid temperature sensors with heat conducting fluid in thermal wells for adequate thermal conductance.

J. Wiring for space sensors shall be concealed in building drywall. EMT conduit is acceptable within mechanical equipment and service rooms.

K. Install central plant outdoor air temperature sensor on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer

3.7 IDENTIFICATION OF HARDWARE AND WIRING

A. All field wiring and cabling, including that within factory mounted, and wired control panels and devices for mechanical equipment, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information for troubleshooting, maintenance, and service purposes. BAS manufacturer to coordinate this labeling requirement with mechanical equipment manufacturer as it relates to controls.

B. Permanently label or code each point of field terminal strips to show the instrument or item served and correlate them to the BAS design drawings.

C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.

D. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.8 CONTROL SYSTEM CHECKOUT AND TESTING

A. Start-up testing. All testing in this section shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.

1. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service all of the instruments, controls, and accessory equipment furnished under this specification.

2. Verify that all control wiring is properly connected and free os all shorts and ground faults. Verify that terminations are tight.

3. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturer's recommendations.

4. Verify all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starter, etc.) operate properly and normal positions are correct.

5. Verify all analog output devices (I/Ps, actuators, etc) are functional, that startand span are correct, and that direection and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.

6. Verify the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops and optimal start/stop routimes.

7. Alarms and Interlocks

   a. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.

   b. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.

   c. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

3.9 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

A. Demonstration: A complete demonstration of the capabilities of the BAS system shall be performed by the BAS manufacturer's field personnel. The BAS manufacturer shall dedicate a minimum of (16) hours on-site with the Owner representatives, and Engineer to demonstrate a complete functional test of all the BAS system requirements. This BAS demonstration shall constitute an acceptance inspection, and will represent the process of approving the BAS as designed and specified. Functional testing shall include, but is not limited to, the following system level components where installed:
   1. Variable Air Volume Systems

      a. Ventilation Reset

         1) Demonstrate system level operation including 15 minute interval trend report of ventilation optimization air setpoint and outdoor air flow (cfm) over one week period. Deliver trend report to Owner representatives and Engineer.

         2) Dynamically show maximum ventilation ratio source VAV on user interfac

      b. Fan Pressure Optimization

         1) Demonstrate system level operation including 15 minute interval trend report of duct static optimization duct static pressure setpoint and duct static pressure over one week period. Deliver trend report to Owner representatives and Engineer.

         2) Dynamically show maximum VAV damper position source on user interface.

B. Acceptance: The BAS will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

3.10 CLEANING

A. Provide The BAS manufacturer's installing contractor(s) shall clean up all debris resulting from their installation activities on a daily basis. The installation contractors shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Owner, Construction Manager, General Contractor, and/or Mechanical Contractor.

B. At the completion of work in any area, the installation contractor shall clean all of their work, equipment, etc., making it free from dust, dirt and debris.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage. Any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.11 TRAINING

A. Provide minimum of (4) classroom training sessions, and (4) hours for each session, throughout the contract period. The training will be provided for personnel designated by the Owner.

B. These objectives will be divided into logical groupings; participants may attend one or more of these, depending on level of knowledge required:

1. Day-to-day BAS Operators
2. BAS Troubleshooting & Maintenance

C. The instructor(s) shall be a controls system programmer, shall be factory-trained and shall be experienced in teaching this technical material.

3.12 WARRANTY REQUIREMENTS

A. Warrant all work as follows:

1. BAS, system controller(s), unit controllers, control devices, sensors, installation and wiring labor and all materials shall be warranted free from defects for a period of twenty-four (24) months after final completion acceptance by the Owner. BAS failures during the warranty period shall be adjusted, repaired, or replaced at no charge to the Owner (Parts and Labor warranty must be provided to the owner by the BAS manufacturer). The BAS manufacturer shall respond to the Owner's request for warranty service within 24 hours of the initiated call and will occur during normal business hours (8AM-5PM).

2. At the end of the final start-up/testing, if equipment and systems are operating satisfactorily to the Owner and Engineer, the Owner shall sign certificates certifying that the BAS is operational, and has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of the warranty period.

3. BAS system controller software, graphics, database, and firmware updates shall be provided to the Owner at no charge during the warranty period. Written authorization by the Owner must be granted prior to the installation of these updates.

4. The BAS manufacturer shall provide a web-accessible Users Network for the proposed System and give the Owner free access to question/answer forum, user tips and training schedules for a two year period of time correlating with the warranty period

END OF SECTION 230900

CORDOGAN CLARK & ASSOCIATES, INC.
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SECTION 231123 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fuel gas piping within the building. Products include the following:

1. Pipe, tube, fittings, and joining materials.
2. Protective pipe and fitting coating.
3. Piping specialties.
4. Specialty valves.
5. Pressure regulators.

B. Related Sections include the following:

1. Division 2 Section "Natural Gas Distribution" for natural gas service piping, specialties, and accessories outside the building.

1.3 PROJECT CONDITIONS

A. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is 2 psig, and is reduced to 0.5 psig.

B. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft.
2. Nominal Specific Gravity: 0.6.

1.4 ACTION SUBMITTALS

A. 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.

1.5 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.

1.6 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than TEN WORKING days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

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 A.

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.
f. All pipe and fittings to be made in USA.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. PE Pipe: ASTM D2513, SDR 11.

1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
c. Aboveground Portion: PE transition fitting.
d. Outlet is threaded or flanged or suitable for welded connection.
e. Tracer wire connection.
f. UV shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
b. Outlet is threaded or flanged or suitable for welded connection.
c. Bridging sleeve over mechanical coupling.
d. Factory-connected anode.
e. Tracer wire connection.
f. UV shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Suitable for joining PE pipe to PE pipe.
a. PE body with molded-in, stainless steel support ring.
b. Seals: NBR.
c. Acetal collets.
d. Electro-zinc-plated steel stiffener.

6. Plastic Mechanical Couplings, NPS 2 and Larger: Suitable for joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
a. Fiber-reinforced plastic body.
b. PE body tube.

c. Seals: NBR.
d. Acetal collets.
e. Stainless steel bolts, nuts, and washers.

7. Steel Mechanical Couplings: Suitable for joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   a. Stainless steel flanges and tube with epoxy finish.
   b. Seals: NBR.
   c. Stainless steel bolts, washers, and nuts.
   d. Factory-installed anode for steel-body couplings installed 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. 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.

C. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Seals: Nitrile.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

D. Y-Pattern Strainers:

1. Body: ASTM A126, 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-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. Basket Strainers:

1. Body: ASTM A126, Class B, high-tensile 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-mesh startup strainer, and perforated stainless steel basket with 50 percent free area.
4. CWP Rating: 125 psig

F. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

2.3 JOINING MATERIALS

A. 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.

B. Joint Compound and Tape: Suitable for natural gas.

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. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    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.

2.5 MOTORIZED GAS VALVES

A. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASCO Power Technologies, LP; Division of Emerson.
b. Dungs, Karl, Inc.
c. Eclipse Combustion, Inc.
d. Goyen Valve Corp.; Tyco Environmental Systems.
e. Magnatrol Valve Corporation.
f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

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.
    h. Sensus

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: 10 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Canadian Meter Company Inc.
    b. Eaton Corporation; Controls Div.
    c. Harper Wyman Co.
    d. Maxitrol Company.
    e. SCP, Inc.
    f. Sensus

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Description:

      a. Standard: ASSE 1079.
      b. Pressure Rating: 150 psig
      c. End Connections: Solder-joint copper alloy and threaded ferrous.

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 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: Rough brass.

D. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.

2.10 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 (34.5-MPa), 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.11 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.

B. Label and identify gas piping and pressure outside a multitenant building by tenant.

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 OUTDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping in accordance with ASTM D2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. 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.

G. 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.

3.4 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 Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

d. Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
e. Piping in Equipment Rooms: One-piece, cast-brass type.
f. 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 individual relief vent connections for service regulators, line regulators, and overpressure protection devices independently to outdoors and terminate with weatherproof vent cap. Regulator vent piping to be steel (copper piping is not acceptable). Do not manifold vent piping from multiple regulators.

Q. Install plugged tee or test plug on both upstream and downstream sides of regulator.

R. 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.

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.

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

3.6 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. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. 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.

E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join in accordance with ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. 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.

3.8 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.

3.9 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.

3.10 PAINTING

A. 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 flat.
    d. Color: To be determined by architect.

B. 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: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex flat
    d. Color: Gray

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

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 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

B. Underground, below building, piping is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
4. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with steel welding fittings and welded joints.

B. Underground, below building, piping is to be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.
3. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
4. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground portion of vent pipe and fittings with protective coating for steel piping.

3.15 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. Two-piece, full-port, bronze ball valves with bronze trim.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

C. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Cast-iron, nonlubricated plug valve.

D. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231123

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SECTION 232113 - 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. Dual-temperature heating and cooling water piping.
4. Condensate-drain piping.
5. Glycol cooling-water piping.
6. Blowdown-Drain Piping
7. Makeup-water piping.
8. Air-vent piping.
9. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
4. Chemical treatment.

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.

4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

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.

E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 175 psig at 200 deg F.
2. Chilled-Water Piping: 150 psig at 100 deg F
3. Glycol Cooling-Water Piping: 150 psig at 100 deg F.
4. Dual-Temperature Heating- and Cooling-Water Piping: 175 psig at 200 deg F.
5. Makeup-Water Piping: 80 psig at 150 deg F.
6. Condensate-Drain Piping: 150 deg F.
7. Air-Vent Piping: 200 deg F.
8. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Tubing and fittings to be made in USA

B. Drawn-Temper Copper Tubing: ASTM B 88, Type L

C. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

D. Wrought-Copper Fittings: ASME B16.22.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. S. P. Fittings; a division of Star Pipe Products.

E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. T-DRILL Industries Inc.

F. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Pipe and fittings to be made in USA.

B. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type E or S, grade A or B.

C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

F. 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 Part 3 "Piping Applications" Article.

G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

H. 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.

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/A5.8M, 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. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

1. Fiberglass adhesive shall have a VOC content of 80 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

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:

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. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F

D. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Company.
    b. Central Plastics Company.
    c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150 or 300-psig minimum working pressure as required to suit system pressures.

E. 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. 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.

3. 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:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

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. Type L, drawn-temper copper tubing, copper press fittings, and press connect joints. (Viega ProPress)

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. 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 (DN 50) and Smaller, to be Any of the Following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Type L, drawn-temper copper tubing, copper press fittings, and press connect joints. (Viega ProPress)

D. Chilled-Water Piping, Aboveground, NPS 2-1/2 and Larger, to Be Any of the Following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

E. Dual-Temperature Heating- and Cooling-Water Piping, Aboveground, NPS 2 and Smaller, to Be Any of the Following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Type L, drawn-temper copper tubing, copper press fittings, and press connect joints. (Viega ProPress)

F. Dual-Temperature Heating and Cooling-Water Piping, Aboveground, NPS 2-1/2 and Larger, to Be Any of the Following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

Retain "either of" option in first paragraph below to allow Contractor to select piping materials from those retained.

A. Condensate-Drain Piping:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Type L, drawn-temper copper tubing, copper press fittings, and press connect joints. (Viega ProPress)

B. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

C. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

D. 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 the piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. 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.

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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. 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.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. 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.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. 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."

W. 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."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

Y. If using press connect system, leave behind one press tool for owner's use after project completion.

3.3 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 unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.4 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. 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.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet
2. NPS 1: Maximum span, 7 feet
3. NPS 1-1/2: Maximum span, 9 feet
4. NPS 2: Maximum span, 10 feet
5. NPS 2-1/2: Maximum span, 11 feet

6. NPS 3 and Larger: Maximum span, 12 feet

E. 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.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 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. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Press Connect Joints shall be made in accordance with the manufacturer’s installation instructions.

G. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 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.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

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

SECTION 232116 - 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. Chilled water piping
3. Dual temperature piping.
4. Condenser-water piping.
5. Makeup-water piping.
6. Condensate-drain piping.
7. Blowdown-drain piping.
8. Air-vent piping.
9. Safety-valve-inlet and -outlet 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 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.6 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 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 175 psig at 200 deg F.
2. Chilled-Water Piping: 150 psig at 150 deg F.
3. Dual temperature Piping: 175 psig at 200 deg F.
4. Makeup-Water Piping: 80 psig at 150 deg F.
5. Condensate-Drain Piping: 150 deg F.
6. Air-Vent Piping: 200 deg F.
7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Brass Calibrated Balance Valves
1. Connections: NPT or solder
2. Body: lead-free brass
3. Ball: 304 stainless steel
4. Seat Rings: glass and carbon filled TFE
5. Readout Valves: brass with EPT check valves
6. Stem O Ring: EPDM
7. Maximum working pressure: 400 psi
8. Operating temperature range: -4F to 250F.
9. Manufacturers

a. Grundfos
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Nexus

g. Tour & Andersson; available through Victaulic Company of America.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Grundfos
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Nexus
   g. Tour & Andersson; available through Victaulic Company of America.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball/disc: brass/stainless steel.
4. Stem Seals: EPDM.
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. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amtrol, Inc.
   b. Grundfos
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, 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. Low inlet-pressure check valve.
8. Inlet Strainer: stainless steel, 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.

2.3 AIR-CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Grundfos
3. Bell & Gossett Domestic Pump; a division of ITT Industries.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Bladder: butyl rubber, field replaceable.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
4. Manufacturers
    a. Bell and Gossett
    b. Amtrol
    c. Grundfos

E. Coalescing Air and Dirt Separator:

1. Tank: Welded steel; ASME constructed and labeled for 150 psig minimum working pressure and at least 375 deg F maximum operating temperature.
2. Coalescing media: copper or stainless steel
3. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
4. Blowdown Connection: Threaded.
5. Size: Match system flow capacity.
6. Lower head to be removable for internal inspection
7. Manufacturers

a. Bell and Gossett
b. Spirotherm
c. Grundfos

2.4 CHILLED WATER SYSTEM EQUIPMENT

A. Buffer Tanks
1. Manufacturers: Lochinvar, Cemline, Wessels, Grundfos.
2. See plans for additional information.

B. Glycol Feeders
1. Manufacturers: Wessels, GTP.
2. See plans for additional information.

2.5 HYDRONIC PIPING SPECIALTIES

A. 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-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Stainless Steel Flexible Connectors:
1. Hose: Corrugated stainless steel – 300 series
2. Braid: Stainless steel – 300 series
3. Flanges: Carbon steel
4. Rating at Design Temperature: 125 psig minimum
5. Lateral Offset: 0.75”
6. Manufacturers: Mason Industries FFL, MetraFlex MLPC, Twin City Hose TCHS,

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

D. Coil kits: coil kits to be made in USA and have stainless steel trim.

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 throttling-duty 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, chilled water systems, 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. 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.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. 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.

G. 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 232123 - 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. This Section includes the following:

1. Close-coupled, in-line centrifugal pumps.
2. Separately coupled, base-mounted, end-suction centrifugal pumps.
3. Separately coupled, horizontal, in-line centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 ACTION SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

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. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

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. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bell and Gossett

B. Grundfos

C. Paco

2.2 PRODUCTS

A. Closed-Couple, In-Line Centrifugal Pumps:
1. Casing: Radially split, cast iron.
2. Impeller: brass.
3. Pump Shaft: stainless steel
4. Seal: Mechanical, internally flushed
5. Maximum working pressure: 175 PSI
6. Maximum working temperature: 250F
7. Provide triple duty valve

B. Separately-Coupled, Base-Mounted, End-Suction Centrifugal Pumps:
1. Casing: Radially split, cast iron. Integral mount on volute to support the casing and attached piping to allow removal and replacement of impeller without disconnection piping or requiring realignment of pump and motor shaft.
2. Impeller: Stainless steel
3. Pump Shaft: Carbon steel, with stainless steel shaft sleeve
4. Seal: Mechanical, internally flushed
5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
6. Shaft Coupling: Drop-out type molded-rubber insert and interlocking spider with EPDM coupling sleeve for variable-speed applications.
7. Coupling Guard: Dual rated, steel, removable, attached to mounting frame.
8. Mounting Frame: Welded-steel frame and cross members.
9. Motor Enclosure Type: Totally enclosed, fan cooled
10. Motor Efficiency: Premium efficient as defined in NEMA MG 1.
11. Motor Speed: Variable
12. Maximum working pressure: 175 PSI
13. Maximum working temperature: 225F
14. Provide with suction diffuser and triple duty valve
15. Provide with inertia base

C. Wet-Rotor Circulation Pump with Integrated Electronically Commutated Motor:

1. Body: Cast iron
2. Impeller: poly-phenylene sulfide or stainless steel
3. Pump Shaft: AISI 420 stainless steel
4. Bearings. Carbon sleeve
5. Motor Efficiency: Premium efficient as defined in NEMA MG 1.
6. Motor: Permanent magnet electronically commutated
7. UL 778 listed
8. Maximum working pressure: 175 PSI
9. Maximum working temperature: 230F
10. Provide non-slam check valve on pump discharge

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

2.4 VARIABLE FREQUENCY DRIVES

A. To be provided by pump supplier

B. Include shaft ground rings

2.5 ELECTRONICALLY COMMUTATED MOTORS (ECMs)

A. For pumps indicated.

B. Synchronous, Constant torque, ECM with permanent magnet rotor

C. Driven by frequency converter

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 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. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

E. Provide and install bearing protection ring on all pumps with an associated VFD.

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers size required to support weight of in-line pumps. Where pump weight exceeds the capacity of elastomeric hangers, provide spring hangers with vertical-limit stop.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation"

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. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of 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, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Install electrical connections for power, controls, and devices.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.6 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.7 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.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Hydronic pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 232123

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SECTION 232300 - REFRIGERANT 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 refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig.
2. Suction Lines for Heat-Pump Applications: 225 psig.
3. Hot-Gas and Liquid Lines: 225 psig.

B. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

C. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.4 INFORMATIONAL SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.

3. Filter dryers.
4. Strainers.
5. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

F. Subject to equipment manufacturer's requirements, preinsulated copper roll with polyethylene closed cell foam shall be an acceptable refrigerant piping material. Copper piping shall meet ASTM B280. Insulation shall meet UL 723 requirements and have a flame and spread index less than 25 and smoke development index less than 50. Product shall be PDM Gelcopper or approved equal.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.

3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Nonadjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

2.4 INSULATION

A. Insulate refrigerant piping with minimum 0.5" flexible elastomeric insulation. Provide thicker insulation where required by VRF manufacturer. Provide PVC jacket over insulation. for exterior applications.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a: Provide PVC jacket over insulation on exterior application.

A. Suction Lines NPS 1 and smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 1-1/4 and larger for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-407C: Provide PVC jacket over insulation on exterior application.

A. Suction Lines NPS 1 and smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 1-1/4 and larger for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.3 PIPING APPLICATIONS FOR REFRIGERANT R-410A: Provide PVC jacket over insulation on exterior application.

A. Suction Lines NPS 1 and smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 1-1/4 and larger for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

3.4 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.

2. Thermostatic expansion valves.
3. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

L. Install flexible connectors at compressors.

3.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements are to be 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

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 adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

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. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

E. Threaded Joints: Thread steel 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. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 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. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Compact Pipe Stand: Pipestand with a strut and clamp pipe support system used for multiple pipes.
1. Base: One-piece 12”x16” stainless steel.
2. Pipe Support: 16” galvanized strut with stainless steel all thread with adjustable height up to 7.5”.
3. Install supports on extra layer of roofing material. Clamp refrigeration piping to strut.
4. Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.9 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.10 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

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SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. State Chemical is District 131's HVAC water treatment contractor. Contact Gary Greenman to arrange for treatment and testing: ggreenman@statechemical.com ; 847-712-3046.

1.2 ACTION SUBMITTALS

A. Product Data: For treatment chemicals.

1.3 INFORMATIONAL SUBMITTALS

A. Water-Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.

B. Water Analysis: Obtain sample of makeup water and provide test report.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider, capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

PART 2 - PRODUCTS

2.1 HVAC WATER-TREATMENT SUPPLIERS / CONTRACTORS

A. State Chemical

2.2 PERFORMANCE REQUIREMENTS

A. Provide all hardware, chemicals, and other material necessary to maintain HVAC water quality in all systems as indicated in this Specification. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating, chilled water cooling, and glycol cooling/heating shall have the following water qualities:

1. pH: Maintain a value within 9-9.5.
2. Molybdate: 100-150 ppm or Sodium Nitrite: 800-1200 ppm
3. Hardness (CaCO3): <200 ppm
4. Steel Corrosion Inhibiters: Provide sufficient inhibitors to limit mild steel corrosion to 0.3 mils per year. Maintain soluble iron concentrations at or below <3 ppm.
5. Yellow Metal Corrosion Inhibitor: Provide sufficient copper and brass corrosion inhibitors to limit copper corrosion to 0.15 mils per year. Maintain soluble copper concentrations <0.2 ppm.
6. Scale Control: Where softened water is not used, provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.
7. Dispersants: Provide sufficient dispersants to prevent sedimentation of fine particulate matter.
8. 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.

9. Propylene glycol (where present): 30% concentration unless noted otherwise on plans. Glycol to be inhibited with dipotassium phosphate.

2.3 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 makeup water supply to determine quality of water available at Project site.

3.2 FIELD QUALITY CONTROL

A. Existing hydronic system pretesting: obtain sample of existing chilled/hot water prior to the start of system modifications and prepare test report.

B. Hydronic system testing: obtain sample of chilled/hot water and prepare test report.

C. Comply with ASTM D3370 and with the following standards:

1. Silica: ASTM D859.
2. Steam System: ASTM D1066.
3. Acidity and Alkalinity: ASTM D1067.
4. Iron: ASTM D1068.
5. Water Hardness: ASTM D1126.

3.3 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above, to inhibit corrosion, scale formation, and biological growth. Services and chemicals shall be provided for a period of one year from date of Substantial Completion and shall include the following:

1. Initial 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. Periodic 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.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION 232500

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round and flat-oval ducts and fittings.
4. Double-wall round and flat-oval ducts and fittings.
5. Metal panel
6. Sheet metal materials.
7. Duct liner.
8. Sealants and gaskets.
9. Hangers and supports.

B. Related Requirements:

1. Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint devices and installation.
2. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
3. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
4. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
5. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 ACTION SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
1. Refer to the front end specifications for additional requirements.

1.3 INFORMATIONAL 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. Elevations of ducts.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

C. Delegated Design Submittals:

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, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Welding certificates.

E. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", International Mechanical Code (year indicated on cover sheet), and with performance requirements and design criteria indicated in "Duct Schedule" Article.
1. Contractor shall install the most stringent duct thickness required by the codes and standards to meet the installation application requirements.

2.2 MANUFACTURERS

1. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.
3. Lindab
4. Linx

2.3 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.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Transverse Joints: Fabricate joints in accordance with 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."

1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with 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. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 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."

2.4 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Source Limitations: Obtain double-wall rectangular ducts and fittings from single manufacturer.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct outer duct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

D. Transverse Joints: Select joint types and fabricate in accordance with 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."

1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

E. Longitudinal Seams: Select seam types and fabricate in accordance with 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: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Liner thickness to be 1” unless noted otherwise on plans.

G. Inner Duct:
1. Perforated: Minimum 24-gauge (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.
    a. Provide polymer film (Mylar or similar) to protect duct liner unless noted otherwise on plans.
2. Solid: Minimum 24-gauge (0.7-mm) solid galvanized sheet steel
3. Inner duct to be perforated unless noted otherwise on plans.

2.5 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Source Limitations: Obtain single-wall round and flat oval ducts and fittings from single manufacturer.

C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

D. Transverse Joints: Select joint types and fabricate in accordance with 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.

E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

F. Tees and Laterals: Select types and fabricate in accordance with 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."

2.6 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. Source Limitations: Obtain double-wall round and flat oval ducts and fittings from single manufacturer.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For ducts exposed to weather, construct outer duct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
3. Transverse Joints: Select joint types and fabricate in accordance with 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.

4. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."

a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

5. Tees and Laterals: Select types and fabricate in accordance with 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."

D. Inner Duct:
1. Perforated: Minimum 24-gauge (0.7-mm) perforated galvanized sheet steel having 3/32-inch-(2.4-mm-) diameter perforations, with overall open area of 23 percent.
a. Provide polymer film (Mylar or similar) to protect duct liner unless noted otherwise on plans.
2. Solid: Minimum 24-gauge (0.7-mm) solid galvanized sheet steel
3. Inner duct to be perforated unless noted otherwise on plans.

E. Interstitial Insulation, Fibrous Glass: Duct liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Liner thickness to be 1” unless noted otherwise on plans.

2.7 METAL PANEL

A. “Metal panel” refers to a double walled sandwich panel consisting of minimum 24-gauge G90 galvanized steel sheets surrounding fiberglass board insulation. Board insulation thickness to be 1.5” unless noted otherwise on plans.

B. Plenum boxes to be constructed of double walled insulated metal panel. Insulation thickness to be 1.5” unless noted otherwise on plans.

2.8 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 are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.
3. Finish for ductwork that will be painted: paint grip.

C. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.

F. Tie Rods: Galvanized steel, 1/4-inch- (6-mm-) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch- (10-mm-) minimum diameter for lengths longer than 36 inches (900 mm).

2.9 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers:
   a. Knauf: Atmosphere
   b. Johns Mansville: Linacoustic RC-HP
   c. Owens Corning: QuietR
2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
   a. Duct liner to be GreenGuard Gold certified.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers:
   a. ArmaCell: ArmaFlex
   b. K-flex
2. Source Limitations: Obtain flexible elastomeric duct liner from single manufacturer.
3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5-

mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel, aluminum, or stainless steel (match duct material); with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) in diameter.

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. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s) or greater.
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. 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.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. 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 (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.10 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. 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 (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and is to be rated for 10-inch wg (2500-Pa) 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.

2.11 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-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 (Table 5-1M), "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 A603.

E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-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 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.

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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. 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 (38 mm).

J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in

Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

N. Branch Connections: Use lateral or conical branch connections.

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 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 TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts exposed to view are to be constructed of stainless steel as per "Duct Schedule" Article. All ducts concealed from view are to be stainless steel as per "Duct Schedule" Article.

D. All joints are to be welded and are to be telescoping, bell, or flange joint as per NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, not more than 10 feet from changes in direction greater than 45 degrees, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS AND OTHER HIGH-HUMIDITY LOCATIONS

A. Install dishwasher exhaust ducts and other exhaust ducts from wet, high-humidity locations without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.

B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch (25-mm) trapped copper drain from each drain pocket to open site floor drain.

C. Minimize number of transverse seams.

D. Do not locate longitudinal seams on bottom of duct.

3.5 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."

B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.

C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

3.6 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:

1. Ductwork is to be Type 316 stainless steel.

2. Where ducts have external insulation, provide weatherproof AlumaGuard jacket, 55 mils thick. Refer to duct insulation schedule on plans and duct schedule in this document for more information.

D. Double Wall:

1. Ductwork complies with requirements in "Double-Wall Rectangular Ducts and Fittings" or "Double-Wall Round and Flat-Oval Ducts and Fittings" Article.
2. Ductwork outer wall is to be Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
3. Provide interstitial insulation.

3.7 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.8 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 (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "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 (610 mm) of each elbow and within 48 inches (1220 mm) 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 (5 m).

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.

3.9 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. See Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraint installation requirements.

3.10 DUCTWORK 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.

3.11 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."

B. Galvanized ductwork that is to be painted shall be installed with paintgrip galvanized finish.

3.12 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. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa); ducts located outdoors: Test representative duct sections totaling no less than 25 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. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
5. Test for leaks before applying external insulation.
6. 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.
7. Give seven days' advance notice for testing.

3.13 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and 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.

E. 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.

F. 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.

G. 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 in accordance with NADCA ACR. 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 in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.14 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.15 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
2. Underground Ducts: BlueDuct

B. Supply Ducts
1. Supply Ducts Connected to Air Handling Units – (0-2” ESP):
    a. Pressure Class: Positive 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 4.
2. Supply Ducts Connected to Air Handling Units – (2-3” ESP):
    a. Pressure Class: Positive 3-inch wg.
    b. Minimum SMACNA Seal Class: A
    c. SMACNA Leakage Class for Rectangular: 4
    d. SMACNA Leakage Class for Round and Flat Oval: 4.
3. Supply Ducts Connected to Air Handling Units – (3-4” ESP):
    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 and Flat Oval: 2.

C. Return Ducts:

1. 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: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 4.

D. 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, negative or positive pressure.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 4.

2. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

    a. Type 316, stainless-steel sheet.

        1) Exposed to View: No. 4 finish.
        2) Concealed: No. 2B finish.

    b. Pressure Class: Positive or negative 3-inch wg.
    c. Minimum SMACNA Seal Class: A.
    d. SMACNA Leakage Class: 4.

3. Ducts Connected to dryer exhaust.
    a. 316 stainless steel.
    b. Minimum SMACNA Seal Class: A, negative or positive pressure.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 4.

4. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

    a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
    b. Concealed: Type 304, stainless-steel sheet, No. 2D finish
    c. Welded seams and joints.
    d. Pressure Class: Positive or negative 2-inch wg
    e. Airtight/watertight

5. Ducts Connected to Dishwashers, Dishwasher Hoods, and Other High-Humidity Locations:

    a. Type 304, stainless steel sheet.
    b. Exposed to View: No. 4 finish.
    c. Concealed: No. 2D finish.
    d. Welded longitudinal seams; welded or flanged transverse joints with watertight EPDM gaskets.
    e. Pressure Class: Positive or negative 2-inch wg.
    f. Airtight/watertight.

6. Outdoor-Air (Not Filtered, Heated, or Cooled):

    a. Pressure Class: Positive or negative 2-inch wg.
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 4.
    d. SMACNA Leakage Class for Round and Flat Oval: 4.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

    a. Exposed to Airstream: Match duct material.
    b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum

F. Liner – Duct systems requiring liner are indicated on plans; refer to plans for thickness and R-value. Where liner is indicated on plans, provide material listed below:

1. Supply-Air Ducts: Fiberglass, Type I
2. Return-Air Ducts: Fiberglass, Type I
3. Exhaust-Air Ducts: Fiberglass, Type I
4. Supply Fan Plenums: Fiberglass, Type I
5. Return- and Exhaust-Fan Plenums: Fiberglass, Type I
6. Transfer Ducts: Fiberglass, Type I
7. Outside-Air Ducts: Elastomeric
8. For exterior ductwork: provide duct type and liner type indicated for air system type. In addition to any liner indicated, provide AlumaGuard wrap (55 mils) over foil-faced board insulation.

G. Double-Wall Duct Interstitial Insulation – Refer to plans for thickness:

1. Supply-Air Ducts: Fiberglass
2. Return-Air Ducts: Fiberglass
3. Exhaust-Air Ducts: Fiberglass
4. Outside-Air Ducts: Fiberglass, with polymer film to protect insulation

H. Elbow Configuration:

1. Rectangular Duct - Requirements for All Velocities: 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 1 with minimum 1.0 radius-to-diameter ratio (only where shown on plans and velocity < 1500 fpm)
    c. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    d. 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) Radius-to Diameter Ratio: 1.5.
2) Radius-to Diameter Ratio: 1.0 (only where shown on plans and velocity < 1500 fpm)

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

I. 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.
b. Rectangular Main to Round Branch: Conical spin in or high efficiency takeoff.

2. Round and Flat Oval: 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.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

J. Transitions:
1. Converging or diverging: Maximum 30 degrees.

END OF SECTION 233113

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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 and pressure relief dampers.
2. Manual volume dampers.
3. Turning vanes.
4. Duct mounted access doors
5. Flexible connectors.
6. Flexible ducts.
7. Fire dampers
8. Ceiling Radiation dampers
9. Combination fire and smoke dampers.
10. Control dampers

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, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. 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/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), 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 (ASTM B 221M), 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 (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Greenheck.
3. Penn Ventilation Company, Inc.
4. Prefco Products, Inc.
5. Ruskin Company.
6. Vent Products Company, Inc.

B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 4-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

D. Blades: 0.025-inch- thick, roll-formed aluminum.

E. Blade Seals: Neoprene.

F. Blade Axles: Nonferrous.

G. Tie Bars and Brackets: Aluminum.

H. Return Spring: Adjustable tension.

2.4 MANUAL VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. METALAIRE, Inc.
3. Penn Ventilation Company, Inc.
4. Ruskin Company.
5. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed

position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: Stainless-steel sleeve.
5. Tie Bars and Brackets: Galvanized steel.

D. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware: Locking quadrant with graduated scale. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

F. Provide volume dampers at all supply/return/exhaust diffuser locations and at branch takeoffs.

2.5 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.

2.6 DUCT-MOUNTED ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:

a. American Warming and Ventilating.
b. CESCO Products.
c. Ductmate Industries, Inc.
d. Flexmaster U.S.A., Inc.
e. Greenheck.
f. McGill AirFlow Corporation.
g. Ventfabrics, Inc.
h. Ward Industries, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Provide number of hinges and locks as follows:

a. Less Than 12 Inches Square: Secure with two sash locks.
b. Up to 18 Inches Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches: Three hinges and two compression latches.
d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Hart & Cooley, Inc.
3. McGill AirFlow Corporation.

B. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene 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.

2.8 FIRE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Greenheck.
3. METALAIRE, Inc.
4. Penn Ventilation Company, Inc.

5. Prefco Products, Inc.
6. Ruskin Company.
7. Vent Products Company, Inc.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Fusible Links: Replaceable, 165 deg F rated.

2.9 CEILING RADIATION DAMPERS

A. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

B. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction; gauge in accordance with UL listing.

C. Blades: Galvanized sheet steel with refractory insulation; gauge in accordance with UL listing.

D. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.

3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Ruskin Company.
6. System Sensor

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 4000-fpm velocity.

D. Fire Rating: 3 hours.

E. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

J. Leakage: Class I

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: two-position action, 24VDC, Belimo.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "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.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft, size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 24 VDC

P. Accessories:

1. Auxiliary switches for signaling.
2. Test and reset switches, remote mounted.

2.11 CONTROL DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. Greenheck.
3. METALAIRE, Inc.
4. Penn Ventilation Company, Inc.
5. Ruskin Company.
6. Vent Products Company, Inc.

B. General Description: Low leak airfoil damper. Leakage <3 cfm/sf at 1” static pressure. AMCA Class 1A.

C. Basis of design product: Ruskin CD50.

D. Construction
1. Frame: extruded aluminum hat channel, minimum 0.125” wall thickness
2. Blades: 6” wide , heavy gauge extruded aluminum, airfoil shape
3. Seals: neoprene edge seals, flexible metal compressible jamb seals
4. Bearings: molded synthetic
5. Linkage: concealed in frame
6. Axles: 0.5” plated steel hex
7. Operating Temperature Range: -72F to 275F

PART 3 - EXECUTION

3.1 INSTALLATION

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. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. 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.

E. Install volume dampers at all ventilation outlets for balancing.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Provide access doors for fire dampers, combination fire/smoke dampers, and motorized control dampers where ducts would otherwise prevent access to these components.

J. 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

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands

Q. Install duct test holes where required for testing and balancing purposes.

R. 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 (6-mm) movement during start and stop of fans.

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. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

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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. Ceiling-mounted ventilators.
2. Centrifugal ventilators - roof downblast.
3. Utility Set fan
4. Square in-line fan
5. Housed destratification fans

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment 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. Design Calculations: Calculate requirements for selecting vibration isolators

5. Design Calculations: Calculate requirements for selecting vibration and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.
   1. Indicate clearance required for installed equipment.
   2. Indicate and maintain a minimum 10'-0" clearances to all outside intakes.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and 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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   1. Loren Cook

   2. Greenheck

   3. ACME

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel removable for service.

D. Back-draft damper: Integral.

E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew or spring retainer attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories (Refer to plans for accessories required for project):

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Motion Sensor: Motion detector with adjustable shutoff timer.
5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless steel springs, and fusible link.
6. Filter: Washable aluminum to fit between fan and grille.
7. Isolation: Rubber-in-shear vibration isolators.
8. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.2 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Loren Cook
2. Greenheck
3. ACME

B. Housing: Downblast; removable spun aluminum; square, one-piece aluminum base with venturi inlet cone.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Fan Drives:

1. Direct drive, with electrically commutated motor.

E. Accessories (Refer to plans for required accessories:

1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
6. Spark-resistant, all-aluminum wheel construction.
7. Mounting Pedestal: Galvanized steel with removable access panel.

F. Prefabricated 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.

1. Configuration: Built-in cant and mounting flange
2. Overall Height 18 inches
3. Sound Curb (When indicated on plans): Curb with sound-absorbing insulation.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.

6. Burglar Bars (When indicated on plans): 1/2-inch steel bars welded in place to form 6-inch squares.
7. Mounting Pedestal: Galvanized steel with removable access panel.

2.3 UTILITY SET FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Loren Cook
2. Greenheck
3. ACME

B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

C. Housing: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Discharge Arrangement: Adjustable to eight standard positions.

D. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: Steel.
2. Blade Type: Backward inclined.

E. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

F. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 120,000 hours.

G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.2.
2. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

H. Accessories:

1. Inlet and Outlet: Flanged.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
4. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
5. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

I. Coatings: Powder-baked enamel.

2.4 SQUARE IN-LINE CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Loren Cook
2. Greenheck
3. ACME

B. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Motor Enclosure: Totally enclosed, fan cooled.

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
3. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
4. Companion Flanges: For inlet and outlet duct connections.
5. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
7. Side Discharge: Flange connector and attachment hardware to provide right-angle discharge on side of unit.

I. Capacities and Characteristics:
   a. Refer to mechanical drawings.

2.5 HOUSED DESTRATIFICATION FANS

A. Manufacturers: ZooFans – no substitutions

B. Enclosure: fire resistant plastic with aerodynamic vanes and discharge grille.

C. Motor: Electronically commutated.

D. Installation Hardware: Cable with Gripple attachment hardware. 5:1 safety factor, UL listed.

E. Warranty: four years.

2.6 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. 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.

2.7 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify according to AMCA 99.

F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Secure roof-mounted fans to roof curbs with zinc-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 suspended units from structure using threaded steel rods and elastomeric hangers.

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. 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."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Retain test requirements below with any combination of paragraphs above.

F. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust belt tension.
7. Adjust damper linkages for proper damper operation.
8. Verify lubrication for bearings and other moving parts.
9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
11. Shut unit down and reconnect automatic temperature-control operators.
12. Remove and replace malfunctioning units and retest as specified above.

G. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "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 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

3.8 WARRANTY

A. 24 months from substantial completion.

END OF SECTION 233423

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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: For power, signal, and control wiring.
   3. Hangers and supports, including methods for duct and building attachment[**, seismic restraints,**] and vibration isolation.

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 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.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

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.

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane; a business of American Standard Companies.
2. Titus.
3. MetalAire

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.034-inch, single wall.

1. Casing Lining: Adhesive attached, **1/2-inch** thick, 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. Cover liner with nonporous foil.

b. Cover liner with nonporous foil and perforated metal where indicated.

D. Casing: 0.034-inch steel, single.

1. Casing Lining: Internally lined with nonporous, with 4 pound density sealed liner which complies to UL 181 and NFPA 90A.
2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: Flanged duct connection.
4. Fan: Forward-curved centrifugal, located at plenum air inlet.
5. requirements in ASHRAE 62.1-2004.

E. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg 6-inch wg inlet static pressure.
2. Damper Position: Normally open.

F. Velocity Sensors: Multipoint array with velocity sensors in cold- and hot-deck air inlets and air outlets.

G. 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.

H. Direct Digital Controls: Single-package unitary controller and actuator specified in Division 23 Section "Instrumentation and Control for HVAC."

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

C. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 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, **coil type,** 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. Provide and install R6 wrap insulation around heating coils.

E. Provide and install access door for hot water coil in ductwork downstream of VAV box.

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 (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) 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. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

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. 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.

B. 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.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. **Perform** startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
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. **Train** Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

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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. Section Includes:

1. Ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Perforated diffusers.
4. Linear slot diffusers.
5. Fixed face registers and grilles.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to 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.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Carnes.
   b. Krueger.
   c. METALAIRE, Inc.
   d. Nailor Industries Inc.
   e. Price Industries.
   f. Titus.
   g. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Plaque.
7. Mounting: T-bar.
8. Pattern: Fixed.
9. Dampers: None.
10. Provide plaster frame at drywall ceilings.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Carnes.
   b. Hart & Cooley Inc.
   c. Krueger.
   d. METALAIRE, Inc.
   e. Nailor Industries Inc.
   f. Price Industries.
   g. Titus.
   h. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Steel, insulated.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: Baked enamel, black.
6. Finish - Pattern Controller: Baked enamel, black.
7. Finish - Tees: Baked enamel, white.

8. Slot Width: Refer to mechanical schedule.
9. Number of Slots: Refer to mechanical schedule.
10. Length: Refer to mechanical schedule.
11. Accessories: Center notch where required.

2.3 PERFORATED DIFFUSERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carnes.
    b. Hart & Cooley Inc.
    c. Krueger.
    d. METALAIRE, Inc.
    e. Nailor Industries Inc.
    f. Price Industries.
    g. Titus.
    h. Tuttle & Bailey.

B. Devices shall be specifically designed for variable-air-volume flows.

C. Material: Steel backpan and pattern controllers, with steel or aluminum face. Refer to schedule.

D. Finish: Baked enamel, white

E. Face Size: 24 by 24 inches

F. Duct Inlet: Round or Square.

G. Face Style: Flush

H. Mounting: T-bar

I. Pattern Controller: None.

J. Dampers: None

K. Accessories:

1. Equalizing grid.
2. Plaster ring.

2.4 REGISTERS AND GRILLES

A. Fixed Face Register:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A-J Manufacturing Co., Inc.
    b. Anemostat Products; a Mestek company.

c. Carnes.
d. Dayus Register & Grille Inc.
e. Hart & Cooley Inc.
f. Krueger.
g. Nailor Industries Inc.
h. Price Industries.
i. Titus.
j. Tuttle & Bailey.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch core.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting Frame: Filter.
8. Mounting: Countersunk screw.
9. Damper Type: None.
10. Accessory: None

2.5 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.

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.

END OF SECTION 233713

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SECTION 089000 - LOUVERS AND VENTS

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.

2. FEMA approved stationary blade louver

B. Related Sections:

1. Division 04 Section "Unit Masonry" for building wall vents (brick vents) into masonry.
2. Division 23 Sections for louvers that are a part of mechanical equipment.
3. Division 23 Section "Instrumentation and Control for HVAC" for electric, electronic, and pneumatic control of adjustable louvers.
4. Division 26 Sections for electrical power connections for motor-operated adjustable 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.

E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

F. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

G. Federal Emergency Management Agency (FEMA) 361 – Design and Construction Guidance for Community Safe Rooms.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

D. 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.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

1.6 INFORMATIONAL SUBMITTALS

A. 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.
3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

B. Samples for Verification: For each type of metal finish required.

C. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. 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.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. Product Qualifications:
1. Louvers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance and water penetration ratings.
2. Louvers shall be factory engineered to withstand the specified seismic loads.
    a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.5.

D. 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.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.2 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. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.

D. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant 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.

E. 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 per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. 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.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
3. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

G. Provide extended sills for recessed louvers.

H. 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.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Sightproof, Drainable Blade, Wind-Driven Rain Resistant Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Company; EME520DD Wind-Driven Rain Resistant Stationary Louver or comparable product by one of the following:
   a. Air Flow Company, Inc.
   b. Greenheck Corporation.

2. Louver Depth: 5 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.08 inches for blades and 0.094 inches for frames.
4. Louver Performance Ratings:

   a. Free Area: 47% nominal
   b. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 400 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5 FEMA APPROVED DOUBLE DRAINABLE BLADE LOUVERS

A. MANUFACTURERS:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Company model number XP500WD or comparable product by one of the following:
    a. Air Flow Company, Inc.
    b. Greenheck Corporation.

B. FABRICATION: Formed Aluminum stationary horizontal chevron louver style.

1. Frame:
    a. Frame Depth: 5.5 inches
    b. Wall Thickness: 0.1875 inch, nominal.
    c. Material: extruded aluminum.
2. Blades:
    a. Style: Horizontal double drainable sightproof blade.
    b. Wall Thickness: 0.1875, nominal.
    c. Material: formed aluminum.
3. Minimum assembly size: 12 inches wide by 12 inches high (305 mm x 305 mm).
4. Maximum assembly size: Unlimited width by 96 inches high; 72 inches width by unlimited height.

C. Performance Data:
1. Free Area: 27 percent, nominal.
2. Maximum Pressure Drop (Intake): 0.1 inches w.g.

D. Design Pressure:
    a. +/- 300 PSF up to 78 inches high (1981 mm).

E. Compliance
1. ICC500, FEMA Guideline P-361; FEMA Guideline P-320; UL.

2.6 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 stainless-steel machine screws, 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: Mill finish unless otherwise indicated.
3. Type: Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 5/8-inch-square mesh, 0.04-inch wire.

2.7 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels with clips.

2.8 FINISHES.

A. 70 percent PVDF: Finish shall be applied at 1.2 mil total dry film thickness.
1. Coating shall conform to AAMA 2605. Apply coating following cleaning and pretreatment. Cleaning: AA-C12C42R1X.
   a. Standard 2-coat.
   b. Pearledize 70 (2-coat mica).
   c. 3-coat metallic.
   d. 3-coat exotic.
2. 20-year finish warranty.
3. Color: Custom
4. Color: Manufacturer’s standard

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.

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.

B. Clean opening thoroughly prior to installation.

C. Prepare surfaces using the methods recommended by the manufacture for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install louvers at location indicated on the drawings and in accordance with manufactures' instructions.

B. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

C. Secure FEMA rated louver to structure to comply with FEMA 361 and the following:
   1. Substate CMU, Grout filled. 1500 Min PSI
      a. Anchor Type: ¾ inch diameter Hilti HIT HY 150X8 in long threaded adhesive anchor.
      b. Embedment: 6-3/4 inches minimum.
      c. Factory Attachment angle secured at factory.
      d. Shipped loose attachment angle: 4 in x 6in x 20in long A36 HDG angle. ½ in thick.
   2. Substrate: Concrete 2500 PSI Minimum Compression Strength.
      a. Anchor Type: Hilti Kwik Bolt TZ CS III ½ (6) diameter x 3-3/4 in (95) long
      b. Embedment: 3-1/2 inches minimum.
      c. Factory Attachment Angle secured at factory.
   3. Substrate: Steel Framing
      a. Factory Attachment Angle secured at factory.

D. Apply field topcoat within 6 months of application of shop prime coat.

E. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

F. Form closely fitted joints with exposed connections accurately located and secured.

G. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

I. Protect unpainted galvanized and nonferrous-metal surfaces that will be 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.

J. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents 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 and vents 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 089000

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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

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.
   5. Building-heating-appliance chimneys.
   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.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

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: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schebler eVent DualSeal.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F (248 deg C) continuously, with positive or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1-inch (13-mm) airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Aluminized 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: Exit cone with drain section incorporated into riser.

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 Chimney Liners: High-efficiency boiler or furnace vents in masonry chimney, dishwasher exhaust, or Type II commercial kitchen hood.

B. Listed Type B and BW Vents: Vents for certified gas appliances.

C. Listed Type L Vent: Vents for low-heat appliances.

D. Listed Special Gas Vent: Condensing gas appliances.

E. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.

F. Listed Grease Ducts: Type I commercial kitchen grease duct.

G. Listed, Refractory-Lined Metal Breechings and Chimneys: Freestanding dual-fuel boiler vents, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

H. Field-Fabricated Metal Breechings and Chimneys: Dual-fuel boilers, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

I. 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.

F. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

G. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

H. Erect stacks plumb to finished tolerance of no more than 1 inch (25 mm) out of plumb from top to bottom.

3.4 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

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SECTION 235239 - STAINLESS STEEL FIRETUBE CONDENSING BOILERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, firetube duplex stainless steel ultra-high efficiency condensing boilers, trim and accessories for generating hot water.

1.2 REFERENCES

A. ASME Section IV

B. CAN-1.3.1-77, Industrial and Commercial Gas Fired Packaged Boilers

C. CSD-1, Controls and Safety Devices

D. XL GAPS

E. NEC, National Electric Code

F. UL-795 7th Edition

G. AHRI, BTS-2000

H. ASHRAE 90.1

1.3 ACTION SUBMITTALS

A. Product Data: Include performance data, operating characteristics, technical product data, rated capacities of selected model, weights (shipping, installed and operating), installation and start-up instructions, and furnished accessory information.

B. Shop Drawings: For boiler, standard boiler trim and accessories.

1. End Assembly Drawing: Detail overall dimensions, connection sizes, connection locations, and clearance requirements.

2. Wiring Diagrams: Detail electrical requirements for the boiler including ladder type wiring diagrams for power, interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

3. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

a. Indicate clearance required for installed equipment.

C. Certificate of Product Rating: Submit AHRI Certificate indicating Thermal Efficiency, Combustion Efficiency, Materials of Construction, Input, and Gross Output conform to the design basis.

1.4 INFORMATIONAL SUBMITTALS

A. Thermal efficiency curves: Submit thermal efficiency curves for a minimum of 5 input rates between and including minimum and maximum rated capacities, for return water temperatures ranging from 80°F to 180°F.

B. Water side pressure drop curve.

C. Flue gas temperature curves: Submit flue gas temperature curves for minimum and maximum boiler capacity, for return water temperatures ranging from 80°F to 160°F.

1. If submitted flue gas temperatures, minimum or maximum inputs are different from that of the basis of design manufacturer and model, the manufacturer shall be responsible for draft calculations and reselection of the flue gas exhaust system.

D. Source quality-control test reports.

E. Field quality-control test reports: Start-up by a factory authorized service company.

F. Operation and Maintenance Data: Data to be included in Installation and Operation Manual.

G. Warranty: Standard warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms regularly engaged in the manufacture of condensing hydronic boilers with welded steel pressure vessels, whose products have been in satisfactory use in service for not less than twenty-five (25) years. The manufacturer must be privately owned and headquartered in North America. Finished products manufactured in ASME-certified facility. The specifying engineer, contractor and end customer must have the option to visit the factory during the manufacture of the boilers and be able to witness test fire and other relevant procedures.

B. Aftermarket Support and Service: The manufacturer shall have a factory authorized service training program, where boiler technicians can attend a training class and obtain certification to perform start-up, maintenance and basic troubleshooting specific to the product line. The boiler manufacturer shall have a minimum of 10 full time service technicians on staff.

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.

D. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code, Section IV “Heating Boilers”, for a maximum allowable working pressure of 160 PSIG.

E. CSD-1 Compliance: The boiler shall comply with ASME Controls and Safety Devices for Automatically Fired Boilers (CSD-1).

F. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to “Gas and Oil Fired Boilers - Minimum Efficiency Requirements.”

G. UL Compliance: Boilers must be tested for compliance with UL 795, “Commercial-Industrial Gas Heating Equipment.” Boilers shall be listed and labeled by ETL.

H. AHRI Compliance: Boilers shall be tested and rated according to the BTS-2000 test standard and verified by AHRI.

I. NOx Emissions Compliance: Boiler shall be tested for compliance with SCAQMD and TCEQ.

J. The equipment shall be of the type, design, and size that the manufacturer currently offers for sale and appears in the manufacturer’s current catalog.

K. The equipment shall fit within the allocated space, leaving ample allowance for maintenance and inspection.

L. The equipment shall be new and fabricated from new materials. The equipment shall be free from defects in materials and workmanship.

M. All units of the same classification shall be identical to the extent necessary to ensure interchangeability of parts, assemblies, accessories, and spare parts wherever possible.

N. In order to provide unit responsibility for the specified capacities, efficiencies, and performance, the boiler manufacturer shall certify in writing that the equipment being submitted shall perform as specified.

1.6 COORDINATION

A. Mechanical contractor shall coordinate the size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete reinforcement and formwork requirements are specified in Division 03.

1.7 WARRANTY

A. Standard Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for the Pressure Vessel and Heat Exchanger: The boiler manufacturer shall warranty against failure due to thermal shock, flue gas condensate corrosion, and/or defective material or workmanship for a period of 10 years, non-prorated, from the date of shipment from the factory provided the boiler is installed, controlled, operated and maintained in accordance with the Installation, Operation and Maintenance Manual.

2. Warranty Period for all other components: The boiler manufacturer will repair or replace any part of the boiler that is found to be defective in workmanship or material within (24) months from start-up.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. This specification is based on the Endura series boilers as manufactured by Fulton Heating Solutions, Inc. Equivalent units and manufacturers must meet all performance criteria.

B. Basis-of-Design Product: Subject to compliance with requirements, provide Fulton Heating Solutions, Inc.; Endura model EDR(+) duplex stainless steel firetube condensing boilers.

C. Other Products: Cleaver Brooks Clearfire-CE, Bosch.

2.2 CONSTRUCTION

A. Description: Factory-fabricated, -assembled, and -pressure tested, duplex stainless steel firetube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including flue gas vent; combustion air intake connections, water supply, water return, condensate drain, and controls. The boiler, burner and controls shall be completely factory assembled as a self-contained unit. Each boiler shall be neatly finished, thoroughly tested, and properly packaged for shipping. Closed-loop water heating service only.

B. Heat Exchanger: The heat exchanger is defined as the surfaces of the pressure vessel where flue gases transfer sensible and latent heat to the hydronic fluid.

1. The boiler shall be a single-pass firetube design, such that all combustion chamber components are within water-backed areas. Watertube boilers will not be accepted.

2. Furnace to tube connections shall be constructed with low weld intensity, a tube to tube minimum spacing of 2 tube diameters center to center, minimum 1 tube diameter tube to tube ligament, and shall not contain any overlapping welds.

3. Heat transfer capability shall be maximized via the use of corrugated firetubes. The corrugation process shall not remove any material from the tubes. Finned, twisted tape, or coil type tube inserts negatively impact ease of maintenance and will not be accepted.

4. The boiler shall compensate for heat exchanger thermal expansion using a stress relief deflection element external to the pressure vessel shell. The deflection element shall act to protect the boiler tubes and tubesheets from exposure to longitudinal thermal expansion stresses. The deflection element shall not be in contact with flue gases.

    a. Designs using the tubes, tubesheets, or furnace components to compensate for thermal expansion require cutting, welding, tube repair, or complete heat exchanger replacement in the event of deflection element failure and are not accepted.

    b. Designs which do not compensate for thermal expansion stresses are not accepted.

5. Tubesheet to tube weld stresses while the boiler is in operation shall never exceed 1.0 ksi.

6. Material: The heat exchanger furnace, tubesheets, and firetubes shall be constructed of duplex alloy stainless steel. Austenitic stainless steels, such as 316L or 304, and ferritic stainless steels, such as 439, are not accepted.

a. For long term durability, heat exchanger material of construction must have a minimum Ultimate Tensile Strength of 101 ksi, and a minimum 0.2% Yield Strength of 77 ksi. Weaker materials of construction with reduced strength are not accepted. Boilers seeking an approval must provide documentation that supports this requirement or will be rejected.

b. Heat exchangers constructed of cast aluminum, mild steel, cast iron or copper finned tube materials are not accepted.

C. Exhaust manifold shall be minimum 0.5" thick stainless steel, ASME designation SA-351 CF3M, and shall be a water-backed design to enhance heat transfer. Dry-back style flue gas condensate collection pan exhaust manifolds are not accepted.

D. Pressure Vessel: Design and construction shall be in accordance with Section IV of the ASME Code for heating boilers.

1. The shell shall be minimum **0.375"** thick steel, SA-790 or SA-516 Grade 70.

2. The top head shall be a minimum 0.5" thick steel, SA-790 or SA-516 Grade 70.

3. The water side of the pressure vessel shall be a counter-flow design with internal water-baffling plates.

4. The boiler return and supply water connections shall be **150# ANSI flanged**. The water connections shall not be designed to support an external structural load from the piping system.

E. Burner: Standard natural gas, forced draft.

1. Turndown: refer to schedule**.**

2. Excess Air: The burner shall operate at no greater than 8.0% excess O_2 over the entire modulation range to maximize seasonal combustion and thermal efficiencies.

3. NOx Emissions: When operating on natural gas, the burner shall maintain a level of <20 ppm over the complete combustion range at a 3% O_2 correction.

F. Blower: Variable speed, non sparking, hardened aluminum impeller centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.

1. Motor: Brushless DC variable speed motor with hall effect sensor feedback; internal electronic commutation controller with built in speed control and protection features; long life, sealed, ball bearing with high temperature grease.

2. Variable speed blower: PWM signal input with tachometer output.

G. Main Fuel Train:

1. The boiler shall have a pre-mix combustion system, capable of operating at a minimum 4" W.C. incoming natural gas pressure while simultaneously achieving emissions performance, full modulation, and full rated input capacity. Maximum natural gas pressure allowed to the inlet of the fuel train shall be no less than 28" W.C.

2. A factory mounted main fuel train shall be supplied. The fuel train shall be fully assembled complete with high and low gas pressure switches, wired, and installed on the boiler and shall comply with CSD-1 code. The fuel train components shall be enclosed within the boiler cabinet.

3. A lock up regulator upstream of the fuel train shall be furnished by the boiler manufacturer as a standard component integral to the boiler cabinet. Factory test fire of the boiler with the provided lock up regulator is required.

4. Standard CSD-1 fuel train shall comply with IRI, which has been replaced by XL GAPS.

H. Ignition: Direct spark ignition with transformer. Pilot assemblies are not accepted. A UV scanner shall be utilized to ensure precise communication of flame status back to the flame programmer. Flame rods are not accepted.

I. Boiler Enclosure:

1. Sealed Cabinet: Jacketed steel enclosure with left hinged full height front access door, fully removable latching access panels, gasketed seams to maintain sealed combustion, mounted on a steel skid with steel plate decking.

2. Control Enclosure: NEMA 250, Type 1.

3. Finish: Internally and externally primed and painted finish.

4. Combustion Air: Drawn from the inside of the sealed cabinet, preheating the combustion air.

J. Rigging and Placement: The boiler shall come with lifting eyes and fork hole accessibility for rigging.

K. Characteristics and Capacities:

1. Heating Medium: Closed loop hot water with up to 50% propylene or ethylene glycol by volume. Standard capacities shall be based on 100% water.

2. Design Water Pressure Rating: 160 psig.

3. Safety Relief Valve Setting: **100** psig.

4. Minimum Return Water Temperature: No minimum temperature required.

5. Maximum Allowable Water Temperature (AMSE) : 210°F.

6. Minimum Water Flow Rate: 75 gpm

7. Maximum Delta-T: 100°F

8. Maximum allowable operating setpoint: 200 °F.

9. Side Clearance: Shall not exceed 1” between any number of boilers.

10. Jacket Losses: External convection and radiation heat losses to the boiler room from the boiler shall comply with IAW ASHRAE 103-2007, and shall not exceed 0.2% of the rated boiler input at maximum capacity.

L. The boiler shall have its efficiency witnessed and certified by an independent third party, and the efficiency must be listed on the AHRI directory (www.ahridirectory.org) for natural gas operation. The test parameters for efficiency certification shall be the BTS-2000 standard. The certified thermal efficiency for natural gas firing shall not be less than **95.9%**.

M. A zero flow or low flow condition shall not cause any harm to the pressure vessel or heat exchanger of the boiler. Flow switches, dedicated circulator pumps, or primary-secondary arrangements shall not be required to protect the boiler from thermal shock. Boilers requiring the use of flow switches or primary-secondary piping arrangements are unacceptable.

N. The equipment shall be in strict compliance with the requirements of this specification and shall be the manufacturer's standard commercial product unless specified otherwise. Additional equipment features, details, accessories, etc. which are not specifically identified but which are a part of the manufacturer's standard commercial product, shall be included in the equipment being furnished.

2.3 TRIM

A. Safety Relief Valve: ASME Rated.

B. Pressure and Temperature Gauge: Minimum 3-1/2" diameter, combination pressure and -temperature gauge. Gauges shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

1. Mounted in the field in the boiler supply water piping prior to the first isolation valve by the boiler installer.

C. Combustion Air Inlet Filter: 50 Micron.

D. Flue Gas Condensate Drain Trap: A flue gas condensate drain trap shall be provided to prevent positive pressure exhaust gases from entering the boiler room.

E. Flue Gas Condensate Neutralization: pH neutralization accommodations available upon request.

2.4 CONTROLS

A. The boiler electrical control panel shall include the following devices and features:

1. 7" color touch screen control display factory mounted on the front cabinet panel door.

a. The control display shall serve as a user interface for programming parameters, boiler control and monitoring; and shall feature a screen saver, screen disable for cleaning, contrast control, volume control for alarm features, boiler status, configuration, history and diagnostics.

2. The boiler control panel shall be constructed in a UL 508 approved panel shop.

3. 24 VAC control transformer.

4. Control relay for 120 VAC motorized isolation valve control.

5. The flame safeguard control on the boiler shall be integrated with temperature control and lead/lag sequencing modular boiler plant functionality.

6. All controls are to be cabinet, vessel or panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls. All controls shall be mounted and wired according to UL requirements.

B. Burner Operating Controls: To maintain safe operating conditions, factory mounted and wired burner safety controls limit burner operation:

1. High Limit: A single UL 353 temperature probe shall function as a dual-element outlet temperature sensor and shall comply with CSD-1 CW-400 requirements for 2 independent temperature control devices.

a. High limit sensor shall be NTC resistive 10KOhm +/- 1% at 77°F. Sensor shall have brass material bulb with 1.181 +/- 0.015" insertion and 0.370 +/- 0.005" bulb diameter.

b. Manual reset stops burner if operating conditions rise above maximum boiler design temperature.

2. Low-Water Cut Off: Electronic probe type mounted in the pressure vessel shall prevent burner operation on low water alarm.

3. Air Safety Switch: Prevent operation unless sufficient combustion air is proven.

4. High Condensate Probe: Prevent operation in the event of a blocked condensate drain.

5. Blocked Exhaust: Prevent operation in the event of a blocked flue gas exhaust stack.

C. Boiler Operating Controls and Features:

1. Proportional Integral Derivative (PID) temperature load control capability for up to two loops, central heat and domestic hot water.

2. Operating temperature limit for automatic start and stop.

3. Flue gas exhaust temperature monitoring.

4. Return water temperature monitoring.

5. Time of day display.

6. Customizable boiler name display.

7. Alarm history for 15 most recent alarms including equipment status at time of lockout.

8. Password protection options.

9. Indirect domestic hot water priority.

10. Outdoor air temperature (OAT) reset controls with warm weather shutdown:

a. OAT reset shall automatically adjust the setpoint according to changes in the outdoor temperature.

b. The boiler manufacturer shall provide an OAT sensor and module.

c. The sensor shall have +/- 1.5°F accuracy at 70°F, field installed in an outdoor area not exposed to direct sunlight or the exhaust of other mechanical equipment, and field wired to the master boiler.

d. The control shall be field programmed with the outdoor reset schedule. Refer to temperature control drawings for OAT reset schedule.

e. The control shall have the ability to disable the entire hydronic boiler system on warm weather shutdown based on a programmable OAT.

D. Sequencing Control of Modular Boiler Plants: Sequencing capabilities (lead/lag) shall be integral to the boiler controller for up to 8 boilers installed in the same hydronic loop and shall not require an external panel.

1. The boiler manufacturer shall provide a supply water header temperature sensor.

a. The sensor shall be NTC resistive 10KOhm +/- 1% at 77°F, field installed in the common supply water piping, and field wired to the master boiler.

2. One (1) boiler in the system shall be field programmed as the master and subsequent boilers will be programmed as lag units.

3. Sequence of Operation:

    a. Upon call for heat and demand in the system, a boiler will be enabled at low fire and will modulate according to demand and PID settings up to the base load common value. The base load common shall be field adjustable with a default setting of 40%.

    b. If the heating load exceeds the output at the base load common firing rate, the next boiler in the sequence will be enabled at low fire. Modular boilers will modulate up and down in parallel as a cohesive unit with infinite modulation points to meet heating load requirements.

    c. This process continues until all available boilers are enabled, at which point they are released to modulate up to full fire if required.

    d. As the load decreases, the boilers will be sequentially disabled.

    e. Boiler sequence order shall be rotated on a programmable number of run hours.

    f. A boiler in lockout alarm shall be automatically removed from the sequence order.

    g. Lag boilers shall default to local control if the master boiler is fully powered off or removed.

    h. Each individual boiler shall enable and disable a water circulation control device. The enable of the device, for example a motorized isolation valve or boiler circulator, will be simultaneous with the heat demand for that boiler. The disable of each device will be based on a programmable time delay when the heat demand is no longer present. In variable primary arrangements, the control shall hold the lead boiler isolation valve open at all times.

E. Building Automation System Interface: Hardware and software to enable building automation system (BAS) to monitor, control, and display boiler status and alarms.

1. Hardwired Contacts:

    a. Monitoring: Boiler Status, Burner Demand, General Alarm, Firing Rate.

    b. Control with Factory Installed Jumper: Safety Interlock for External Device, Remote Boiler Enable, Remote Lead/Lag Enable, Emergency Stop (E-Stop)

    c. Remote Setpoint Signal: 4-20 mA.

2. Communication Protocol: A communication interface with BAS shall enable BAS operator to remotely enable and monitor the boiler plant from an operator workstation.

    a. The boilers will communicate with each other and the Building Automation System via a daisy chain addressed Modbus network. Field wiring between nodes shall be twisted pair low voltage with shielded ground.

    b. A BACnet MSTP and IP protocol communication gateway shall be provided. The BACnet gateway is field installed on the MASTER boiler. Lag boilers shall not require a dedicated BACnet gateway for the BAS to monitor status. The BAS shall only be required to communicate through the MASTER boiler. A communication point mapping list shall be provided.

2.5 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and factory-wired switches, transformers, control and safety devices and other devices shall provide a single-point field power connection to the boiler.

1. Provide lockable disconnect switch.

B. Electrical Characteristics:

1. Refer to plans.

2.6 VENTING

A. The boiler shall be capable of operating with a stack effect not exceeding -0.1" W.C. and a combined air intake and exhaust venting pressure drop not exceeding +1.00" W.C.

B. Combustion Air Intake: It shall be acceptable to either direct vent the boiler using sealed combustion by drawing combustion air in from the outdoors or by drawing air from the mechanical space itself.

1. Sealed Combustion: Schedule 40 PVC pipe or smooth-walled galvanized steel, vent termination with 1/2" x 1/2" mesh bird screen.

2. Mechanical Space: Adequate combustion air and ventilation shall be supplied to the boiler room in accordance with local codes.

C. Flue Gas Exhaust: The flue gas exhaust stack shall be AL 29-4C or 316L stainless steel, listed and labeled to UL-1738 / C-UL S636 for use with Category II/IV appliances, guaranteed appropriate for the application by the manufacturer and supplier of the venting.

D. The boiler shall be capable of common exhaust and intake venting. The draft system shall be designed to prevent the backflow of exhaust gases through idle boilers.

E. Condensate drain piping must be galvanized, stainless steel, or Schedule 40 CPVC. Copper, carbon steel, or PVC pipe materials are not accepted.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

B. Each boiler shall be installed and operated in a functioning hydronic system, inclusive of venting, as part of the manufacturing process. A factory test fire report corresponding to the boiler configuration shall be included with each boiler.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, 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 boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations 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 satisfactory conditions have been verified.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base, minimum 4 inches high. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Install gas-fired boilers according to NFPA 54. Equipment and materials shall be installed in an approved manner and in accordance with the boiler manufacturer's installation requirements.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with the boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

F. Provide and install emergency boiler shutdown button at each boiler room exit.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

C. Connect gas piping to boiler gas train inlet with isolation valve and union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

D. Connect hot water supply and return water connections with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to the nearest floor drain.

F. Install piping from flue gas condensate drain connection to the condensate drain trap and to the nearest floor drain.

G. Boiler Venting:

1. Install flue venting and combustion air-intake.

2. Connect to boiler connections, flue size and type as recommended by the manufacturer.

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. Perform tests and inspections and prepare test reports.

1. After boiler installation is completed, the manufacturer shall provide the services of a field representative to inspect components, assemblies, and equipment installations, including connections and provide startup of the boiler and training to the operator.

2. Arrange with National Board of Boiler and Pressure Vessel Inspectors for inspection of boilers and piping. Obtain certification for completed boiler units, deliver to Owner, and obtain receipt.

B. Tests and inspections:

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.

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. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of startup, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to 2 visits to Project during other than normal occupancy hours for this purpose.

E. Provide an additional start-up service on the installed equipment during winter conditions. The additional start-up service will be scheduled directly with the school district during a peak design day.

3.5 DEMONSTRATION

A. Engage factory authorized technician to train owner's personnel to operate and maintain equipment.

END OF SECTION 235239

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SECTION 236423.13 - Air-Cooled Scroll Water Chillers

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for air-cooled rotary scroll packaged chillers.

1.02 REFERENCES

A. AHRI 550/590 - Standard for Water Chilling Packages using the Vapor Compression Cycle

B. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment

C. ASHRAE 15 - Safety Code for Mechanical Refrigeration

D. ASHRAE 90.1 - Energy Efficient Design of New Buildings

E. UL 1995 - Central Cooling Air Conditioners

F. ASTM B117 - Standard Method of Salt Spray (Fog) Testing

G. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

H. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products

I. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments

J. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings.

K. ISO 9001

L. California Administrative Code - Title 24

1.03 SUBMITTALS

A. Submit dimensional plan and elevation view drawings, weights and loadings, required clearances, location and size of all field connections, electrical requirements and wiring diagrams.

B. Submit product data indicating rated capacities, accessories and any special data.

C. Submit manufacturer's installation instructions.

1.04 REGULATORY REQUIREMENTS

A. Comply with codes and standards specified.

B. Chiller must be built in an ISO 9001 classified facility.

1.05 VERIFICATION OF CAPACITY AND EFFICIENCY

A. All proposals for chiller performance must include an AHRI approved selection method. Verification of date and version of computer program selection or catalog is available through AHRI.

1.06 DELIVERY, HANDLING AND STORAGE

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting chillers.

B. Chiller shall be capable of withstanding -40ºF (-40ºC) to 158ºF (70ºC) storage temperatures for an indefinite period of time.

1.07 WARRANTY

A. 2 year parts and labor warranty – entire unit

B. 5 year parts and labor warranty – compressors

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Trane model CGAM

2.02 CHILLER DESCRIPTION

A. The contractor shall furnish and install air-cooled water chiller with scroll compressors as shown as scheduled on the contract documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

2.03 CHILLER OPERATION

A. Chiller shall be capable of starting and running at outdoor ambient temperatures from 32ºF (0ºC) to 125ºF (52ºC).

B. Chiller shall be capable of operating with a leaving solution temperature range 40ºF to 65ºF (4.4 to 20ºC) without glycol.

C. Chiller shall be capable of starting up with 95ºF (35ºC) entering fluid temperature to the evaporator. Maximum water temperature that can be circulated with the Chiller not operating is 125ºF (52ºC)

D. Chiller shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the controller shall indicate that the chiller is in adaptive mode. If the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.

E. Rapid Restart™ after power restoration. The Chiller shall be capable of starting in 45 seconds.

F. Wide ambient operation; Chiller shall be able to start and operate in ambient conditions from 0ºF (-18ºC) to 125ºF (52ºF). Wide ambient operation is accomplished with factory installed and tested

protection. If field installed wide ambient solution is used, this shall be purchased and installed at contractor expense.

G. Low leaving fluid operation; Chiller shall be capable of low temperature process operation with a leaving solution temperature less than 40ºF (4ºC).

2.04 COMPRESSORS

A. Construct chiller using fully hermetic scroll type compressors with R410A optimized and dedicated scroll profile.

B. Provide direct drive motor cooled by suction gas with only three major moving parts and a completely enclosed compression chamber that leads to increased efficiency.

C. Each compressor shall have overload protection internal to the compressor.

D. Each compressor shall include: centrifugal oil pump, oil level sight glass and oil charging valve.

E. Each compressor will have crankcase heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

2.05 EVAPORATOR

A. The evaporator shall be a high efficiency, brazed plate-to-plate type heat exchanger consisting of parallel plates. Braze plates shall be stainless steel with copper braze material.

B. The water side working pressure shall be rated at 150 psig (10.3 bar) and tested at 1.5 times maximum allowable water side working pressure.

C. The refrigerant side working pressure shall be rated at 460 psig (29.6 bars) and tested at 1.1 maximum allowable refrigerant side working pressure.

D. Insulate the evaporator with a minimum of 0.75 inch (K=0.28) UV rated insulation. If the insulation is field installed, the additional money to cover material and installation costs in the field should be included in the bid.

E. Evaporator heaters shall be factory installed and shall protect chiller down to -20ºF (-29ºC). Contractor shall wire separate power to energize heat tape and protect evaporator while chiller is disconnected from the main power.

F. Provide water drain connection, vent and fittings. Factory installed leaving water temperature control and low temperature cutout sensors.

G. Water connections shall be grooved pipe.

H. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

I. Pump package includes: two high head pumps, VFD, expansion vessels, drainage valves, shut-off valves at entering and leaving connections. The pump package is single point power integrated into the chiller unit power with a separate factory wired control panel. The control of the pump is integrated into the chiller controller. The CH530 displays evaporator pump starts and run-times. Freeze protection down to an ambient of -20ºF (-29ºC) is included as standard. The cold parts of the pump package will also be insulated. Designed with one redundant pump, the chiller controls both pumps through a lead/lag and failure/recovery functionality. A variable speed drive is installed in an additional panel to control the pump. The inverter is adjusted upon start up to balance the system flow and head requirements. The purpose is to save on wasted pump energy caused by a traditional balancing valve.

J. The water tank is factory-installed for easy installation at the building site. The tank is engineered for continuous flow and is fully insulated as standard and is designed with freeze protection down to -20ºF (-29ºC).The purpose of the tank is to increase the chilled water circuit inertia, which is necessary with short water loops. A high circuit inertia reduces the compressor's cycling to increase the compressor life span and allow for more precise water temperature accuracy. It also saves energy as compared to hot gas bypass.

2.06 FANS

A. Low sound fans shall by dynamically balanced and direct driven.

B. All condenser fan TEAO motors have permanently lubricated ball bearings and external overload protection.

2.07 CONDENSER

A. The condenser coils shall consist of copper tubes mechanically bonded into plate-type aluminum fins. A subcooling coil shall be an integral part of the main condenser coil.

B. The condenser coils shall have an integral sub-cooling circuit and shall be designed for at least 650 psig (44.8 bar) working pressure. Leak tested at 650 psig (44.8 bar).

2.08 ENCLOSURES/CHILLER CONSTRUCTION

A. Units shall be constructed of a galvanized steel frame with galvanized steel panels and access doors.

B. Chiller panels, base rails and control panels shall be finished with a baked on powder paint. Control panel doors shall have door stays.

C. Mount starters and Terminal Blocks in a UL 1995 rated weatherproof panel provided with full opening access doors. If a circuit breaker is chosen, it should be a lockable, through-the-door type with an operating handle and clearly visible from outside of chiller indicating if power is on or off.

D. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B117.

2.09 CHILLER MOUNTED STARTER

A. The starter shall be across-the-line configuration, factory-mounted and fully pre-wired to the compressor motor(s) and control panel.

B. Unit shall have a single point power connection.

C. A control power transformer shall be factory-installed and factory-wired to provide unit control power.

D. Control panel shall be dead front construction for enhanced service technician safety

E. Unit wiring shall run in liquid-tight conduit.

F. Power line connection type shall be standard with a terminal block.

G. A molded case standard interrupting capacity circuit breaker shall be factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, making it available to disconnect the chiller from main power. Circuit breaker to be high fault rated.

H. Short circuit current to be high amperage rated.

2.10 REFRIGERANT CIRCUIT

A. All chillers shall have 1 or 2 refrigeration circuits, each with two or three (manifolded) compressor on each circuit.

B. Provide for refrigerant circuit:

1. Liquid line shutoff valve
2. Discharge service valve
3. Filter
4. Liquid line sight glass.
5. Electronic expansion valve sized for maximum operating pressure
6. Charging valve

C. Full operating charge of R410A and oil.

2.11 CONTROLS

A. Factory-mounted to the control panel door, the operator interface has an LCD touch-screen display

B. Display shall consist of a menu driven interface with easy touch screen navigation to organized sub-system reports for compressor, evaporator, and motor information as well as associated diagnostics.

C. The chiller control panel shall provide password protection of all set-points

D. Chilled water temperature control shall be microprocessor-based, proportional and integral controller to show water and refrigerant temperature, refrigerant pressure, and diagnostics. This microprocessor-based controller is to be supplied with each chiller by the chiller manufacturer.

E. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:

1. Run time.
2. Number of starts.
3. Current chiller operating mode.
4. Chilled water set point and set point source.
5. Electrical current limit set point and set point source.
6. Entering and leaving evaporator water temperatures.
7. Saturated evaporator and condenser refrigerant temperatures.
8. Evaporator and condenser refrigerant pressure.
9. Differential oil pressure.
10. Phase reversal/unbalance/single phasing and over/under voltage protection.
11. Low chilled water temperature protection.
12. High and low refrigerant pressure protection.
13. Load limit thermostat to limit compressor loading on high return water temperature.
14. Condenser fan sequencing to automatically cycle fans in response to load, expansion valve pressure, condenser pressure, and differential pressure to optimize chiller efficiency.
15. Display diagnostics.
16. Compressors: Status (on/off), %RLA, anti-short cycle timer, and automatic compressor lead-lag.

F. On chiller, mount weatherproof control panel, containing starters, power and control wiring, factory wired with terminal block power connection. Provide primary and secondary fused control power transformer.

G. The chiller controller shall utilize a microprocessor that will automatically take action to prevent chiller shutdown due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.

H. Provide the following safety controls with indicating lights or diagnostic readouts.

1. Low chilled water temperature protection.
2. High refrigerant pressure.
3. Loss of chilled water flow.
4. Contact for remote emergency shutdown.
5. Motor current overload.
6. Phase reversal/unbalance/single phasing.
7. Over/under voltage.
8. Failure of water temperature sensor used by controller.
9. Compressor status (on or off).

I. Provide the following operating controls:

1. A variable method to control capacity in order to maintain leaving chilled water temperature based on PI algorithms. Five minute solid state anti-recycle timer to prevent compressor from short cycling. Compressor minimum stop-to-start time limit shall be 2 minutes. If a greater than 5 minute start-to-start, or greater than 2 minute stop-to-start timer is included, hot gas bypass shall be provided to insure accurate chilled water temperature control in light load applications.
2. Chilled water pump output relay that closes when the chiller is given a signal to start.
3. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance trip outs.
4. High ambient unloader pressure controller that unloads compressors to keep head pressure under control and help prevent high pressure nuisance trip outs on days when outside ambient is above design.
5. Compressor current sensing unloader chiller that unloads compressors to help prevent current overload nuisance trip outs.
6. Low ambient lockout control with adjustable setpoint.
7. Condenser fan sequencing which adjusts the speed of all fans automatically in response to ambient, condensing pressure and expansion valve pressure differential thereby optimizing chiller efficiency.

J. Provide user interface on the front of the panel. If display is on the inside of the panel, then a control display access door shall be provided to allow access to the display without removal of panels. Provide user interface with a minimum of the following features:

1. Leaving chilled water setpoint adjustment from LCD input
2. Entering and leaving chilled water temperature output
3. Pressure output of condenser
4. Pressure output of evaporator
5. Ambient temperature output
6. Voltage output
7. Current limit setpoint adjustment from LCD input.

K. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.

L. Digital Communications to BAS system shall consist of a BACnet MS/TP interface via a single twisted pair wiring.

2.12 SOUND

A. Acoustics: Manufacturer must provide both sound power and sound pressure data in decibels. Sound pressure data per AHRI 370 must be provided at full load.

B. If manufacturer cannot meet the noise levels, sound attenuation devices and/or barrier walls must be installed to meet this performance level.

C. This option includes acoustical treatment for compressor.

2.13 ACCESSORIES

A. Chiller shall have full architectural louvers panels.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's requirements.

1. Level the chiller using the base rail as a reference. The chiller must be level within 1/2" in over the entire length and width. Use shims as necessary to level the chiller.

3.02 SERVICE AND START-UP

A. Startup - Provide all labor and materials to perform startup. Startup shall be performed by a factory-trained technician from the original equipment manufacturer (OEM). Technician shall confirm that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty. This shall be done in strict accordance with manufacturer's specifications and requirements. Third-party service agencies are not permitted.

B. A start-up log shall be furnished by the factory approved start-up technician to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.

C. Provide local service agent with direct access to factory support on equipment.

D. Factory authorized technician to train owner’s personnel to operate and maintain equipment.

E. During the first 12 months of operation, a factory-trained technician from the original equipment manufacturer (OEM) shall perform quarterly on-site operating inspections to confirm the chiller's operational performance. The manufacturer shall provide the owner with a report describing the condition of the equipment, current operating log, any issues found needing to be addressed, and recommended corrective actions.

END OF SECTION

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SECTION 237313 - CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Applied Air Handling Units.

1.02 REFERENCES

A. AMCA Publication 99 - Standards Handbook.

B. AMCA Publication 611 - Certified Ratings Program - Airflow Measurement Performance

C. AMCA Standard 500-D - Laboratory Methods of Testing Dampers for Rating.

D. ANSI/ABMA Standard 9 - Load Ratings and Fatigue Life for Ball Bearings.

E. ANSI/AMCA Standard 204 - Balance Quality and Vibration Levels for Fans.

F. ANSI/AMCA Standard 610 - Laboratory Methods of Testing Airflow Measuring Stations for Rating.

G. ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.

H. ANSI/AHRI Standard 430 - Central Station Air Handling Units.

I. ANSI/AHRI Standard 1060 - Rating Air-To-Air Energy Recovery Ventilation Equipment

J. ANSI/ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

K. ANSI/ASHARE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.

L. ANSI/ASHARE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

M. ANSI/NEMA MG 1 - Motors and Generators.

N. ANSI/UL 900 - Standard for Safety Air Filter Units.

O. AHRI Standard 260 - Sound rating of Ducted Air Moving and Conditioning Equipment.

P. ASHRAE Standard 84 - Method of Testing Air-to-Air Heat Exchangers.

Q. ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.

R. ASTM B117 - Standard Practice for Operation Salt Spray Apparatus.

S. ASTM C1071 - Thermal and Acoustic Insulation (Mineral Fiber, Duct Lining Material).

T. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings.

U. ASTM E477 - Standard Test Method for Measure Acoustical and Airflow Performance of Duct Liner

V. NFPA 70 - National Electrical Code

W. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.

X. UL 1995 - Standard for Safety Heating and Cooling Equipment

1.03 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with current AHRI Standard 410.

B. Air handling units with fan sections utilizing single fans shall be rated and certified in accordance with AHRI Standard.

C. Air handling units with fan sections utilizing multiple fans shall be rated in accordance with AHRI Standard 430 for airflow, static pressure, and fan speed performance.

D. Airflow monitoring station: Certify airflow measurement station performance in accordance with AMCA 611.

1.04 ACTION SUBMITTALS

A. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.

B. AHU manufacturer shall provide the following information with each shop drawing/product data submission:

1. All electrical, piping, and ductwork requirements, including sizes, connection locations, and connection method recommendations.

2. Each component of the unit shall be identified, and mechanical specifications shall be provided for unit and accessories describing construction, components, and options.

3. All performance data, including capacities and airside and waterside pressure drops, for components.

4. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.

5. For units utilizing multiple fans in a fan section, a fan curve shall be provided showing the performance of the entire bank of fans at design conditions. In addition, a fan curve shall be provided showing the performance of each individual fan in the bank of fans at design conditions. Also a fan curve shall be provided showing the performance of the bank of fans, if one fan is down. The percent redundancy of the bank of fans with one fan down shall be noted on the fan curve or in the tabulated fan data.

6. A filter schedule must be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, unit size, corresponding filter section location within the AHU, filter arrangement (e.g. angled/flat), filter depth, filter type (e.g. pleated media), MERV rating, and filter quantity and size.

7. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.

8. A coil valve coordination schedule shall be provided for each air handling unit supplied by the air handling unit manufacturer. Schedule shall detail unit tag, coil type and corresponding section location within the AHU, valve style (e.g. global, ball), valve type (e.g. electronic 2-way/3-way), valve position (e.g. normally open/closed), size, flow coefficient (CV), and close-off pressure.

9. An electrical MCA - MOP schedule shall be provided for each electrical circuit to which field-power must be supplied. Schedule to detail unit tag, circuit description, voltage/phase/hertz, Minimum Circuit Ampacity (MCA), and calculated Maximum Overcurrent Protection (MOP).

10. Sound data shall be provided using AHRI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000 and 8000Hz.

C. The AHU manufacturer shall provide appropriate sets of submittals as referenced in the General Conditions and shall submit to the Owner electronic copies of the IOM.

D. The AHU manufacturer shall list any exceptions to the specification.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

1. Indicate required equipment clearances.

1.06 REGULATOR REQUIREMENTS

A. Agency Listings/Certifications

1. Unit shall be manufactured to conform to UL 1995 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit. In the event the unit is not UL/CUL or ETL approved, the contractor shall, at his/her expense, provide for a field inspection by a UL/CUL or ETL representative to verify conformance. If necessary, contractor shall perform modifications to the unit to comply with UL/CUL or ETL as directed by the representative, at no additional expense to the owner.

2. Air handling units with multiple direct drive plenum fans, or direct drive plenum fans incorporated with ECM style motors are outside the scope of AHRI 430. These fans however are rated in accordance with AHRI 430.

3. Certify air handling units in accordance with AHRI Standard 430. Units shall be provided with certification label affixed to the unit. If air handling units are not certified or fans are not rated in accordance with AHRI Standard 430 contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

4. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit. If air handling coils are not certified in accordance with AHRI Standard 410, contractor shall be responsible for expenses associated with testing of coils after installation to verify performance of coil(s). Any costs incurred to adjust coils to meet scheduled capacities shall be the sole responsibility of the contractor.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Shipping splits shall be clearly defined on submittal drawings. Cost associated with non-conformance to shop drawings shall be the responsibility of the manufacturer. Each section shall have lifting lugs for field rigging, lifting and final placement of AHU section(s). AHU's less than 100-inches wide shall allow for forklift transport and maneuverability on the jobsite.

C. Deliver units to jobsite with fan motor(s), sheave(s), and belt(s) completely assembled and mounted in units.

D. Unit shall be shipped in a clear shrink-wrap or stretch-wrap to protect unit from in-transit rain and debris per ASHRAE 62.1 recommendations.

E. Installing contractor shall be responsible for storing AHU in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.08 START-UP AND OPERATING REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

1.09 WARRANTY

A. AHU manufacturer shall provide, at no additional cost, a parts and labor warranty that covers a period of two years from unit start-up. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Approved manufacturer shall be Trane.

B. Manufacturer must clearly define any exceptions made to Plans and Specifications. Any deviations in layout or arrangement shall be submitted to consulting engineer prior to bid date. Acceptance of deviation(s) from specifications shall be in the form of written approval from the consulting engineer. Mechanical Contractor is responsible for expenses that occur due to exceptions made.

2.02 GENERAL

A. Manufacturer to provide a full perimeter integral base frame for either ceiling suspension of units or to support and raise all sections of the unit for proper trapping. Base frame will either be bolted construction or welded construction. Refer to schedule for base height and construction type. Contractor will be responsible for providing a housekeeping pad when unit base frame is not of sufficient height to properly trap unit. Unit base frames not constructed of galvanized steel shall be chemically cleaned and coated with both a rust-inhibiting primer and finished coat of rust-inhibiting enamel. Unit base height to be included in total height required for proper trap height.

2.03 UNIT CASING

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel. Casing finished to meet ASTM B117 250-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance - Casing air leakage shall not exceed leak class 6 (CL = 6) per ASHRAE 111 at specified casing pressure, where maximum casing leakage (cfm/100 ft2 of casing surface area) = CL X P0.65.

C. Air leakage shall be determined at 1.00 times maximum casing static pressure up to 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.

D. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

E. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

F. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

G. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

H. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*°F/BTU.

I. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

J. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

K. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

L. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces.

2.04 OUTDOOR UNIT FEATURES

A. Outdoor Casing Details - In addition to all other details specified within for air handling units, units that are installed outdoors shall also comply with the following -

1. Factory Supplied Roofcurb - Roof curbs shall be provided where indicated on the plans and shall be galvanized steel. Roof curb shall support the full perimeter of the air handling unit, including pipe chases. A 2" x 4" nominal wood nailing strip shall be supplied attached to the roof curb. Wood nailing strip shall be of #4 Spruce or #4 Yellow Pine. Roof curb shall include frame work necessary to support supply and return duct installation prior to unit placement. Roof curb shall be shipped loose for field installation prior to unit placement. Roof curb shall be insulated and include vibration isolators.

2.05 ACCESS DOORS

A. Access doors shall be 2-inch double-wall construction. Interior and exterior shall be of the same construction as the interior and exterior wall panels.

B. All doors downstream of the cooling coil shall be provided with a thermal break construction of door panel and door frame.

C. Gasketing shall be provided around the full perimeter of the doors to prevent air leakage.

D. Door hardware shall be surface-mounted to prevent through-cabinet penetrations that could likely weaken the casing leakage and thermal performance.

E. Handle hardware shall be designed to prevent unintended closure.

F. Access doors shall be hinged and removable without the use of specialized tools.

G. Hinges shall be interchangeable with the door handle hardware to allow for alternating door swing in the field to minimize access interference due to unforeseen job site obstructions.

H. Door handle hardware shall be adjustable and visually indicate locking position of door latch external to the section.

I. All doors shall be a 60-inch high when sufficient unit height is available, or the maximum height allowed by the unit height.

J. Multiple door handles shall be provided for each latching point of the door necessary to maintain the specified air leakage integrity of the unit.

2.06 PRIMARY DRAIN PANS

A. All cooling coil sections shall be provided with an insulated, double-wall, galvanized drain pan.

B. The drain pan shall be designed in accordance with ASHRAE 62.1 being of sufficient size to collect all condensation produced from the coil and sloped in two planes, pitched toward drain connections, promoting positive drainage to eliminate stagnant water conditions when unit is installed level and trapped per manufacturer's requirements. See section 2.07, paragraph F

through H for specifications on intermediate drain pans between cooling coils.

C. The outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

D. All drain pan threaded connections shall be visible external to the unit. Threaded connections under the unit floor shall not be accepted.

E. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum 2-1/2-inch beyond the base to ensure adequate room for field piping of condensate traps.

F. The installing contractor is responsible to ensure the unit is installed level, trapped in accordance with the manufacturer's requirements, and visually inspected to ensure proper drainage of condensate.

G. Coil support members inside the drain pan shall be of the same material as the drain pan and coil casing.

H. If drain pans are required for heating coils, access sections, or mixing sections they will be indicated in the plans.

2.07 FANS

A. Fan sections shall have a minimum of one hinged and latched access door located on the drive side of the unit to allow inspection and maintenance of the fan, motor, and drive components. Construct door(s) per Section 2.04.

B. Provide fans of type and class as specified on the schedule. Fan shafts shall be solid steel, coated with a rust-inhibiting coating, and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. All fans shall be statically and dynamically tested by the manufacturer for vibration and alignment as an assembly at the operating RPM to meet design specifications. Fans that are selected with inverter balancing shall first be dynamically balanced at design RPM. The fans then will be checked in the factory from 25% to 100% of design RPM to insure they are operating within vibration tolerance specifications, and that there are no resonant frequency issues throughout this operating range. Inverter balancing that requires lockout frequencies inputted into a variable frequency drive to in order to bypass resonant frequencies shall not be acceptable. If supplied in this manner by the unit manufacturer, the contractor will be responsible for rebalancing in the field after unit installation. Fans selected with inverter balancing shall have a maintenance free, circumferential conductive micro fiber shaft grounding ring installed on the fan motor to discharge shaft currents to ground.

C. Belt-driven fans shall be provided with grease lubricated, self-aligning, anti-friction bearings selected for L-50 200,000-hour average life per ANSI/AFBMA Standard 9. Lubrication lines for both bearings shall be extended to the drive side of the AHU and rigidly attached to support bracket with zerk fittings. Lubrication lines shall be a clear, high-pressure, polymer to aid in visual inspection. If extended lubrication lines are not provided, manufacturer shall provide permanently lubricated bearing with engineering calculations for proof of bearing life.

D. Fans, including belt driven and direct drive plenum fans with integral frame motors, shall be mounted on isolation bases. Internally-mounted motor shall be on the same isolation base. Fan and motor shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor in order to avoid transmission of noise and vibration through the ductwork and building structure.

E. MOTORS AND DRIVES

1. All motors and drives shall be factory-installed and run tested. All motors shall be installed on a slide base to permit adjustment of belt tension. Slide base shall be designed to accept all motor sizes offered by the air-handler manufacturer for that fan size to allow a motor change in the future, should airflow requirements change. Fan sections without factory-installed motors shall have motors field installed by the contractor. The contractor shall be responsible for all costs associated with installation of motor and drive, alignment of sheaves and belts, run testing of the motor, and balancing of the assembly.

2. Motors shall meet or exceed all NEMA Standards Publication MG 1 - 2006 requirements and comply with NEMA Premium efficiency levels when applicable. Motors shall comply with applicable requirements of NEC and shall be UL Listed.

3. Fan Motors shall be heavy duty, open drip-proof operable at 460 volts, 60Hz, 3-phase. If applicable, motor efficiency shall meet or exceed NEMA Premium efficiencies.

4. Belt driven fans shall use 4-pole, 1800 rpm, motors, NEMA B design, with Class B insulation, capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.

5. Direct driven fans utilizing integral frame motors shall use 2-pole (3600 rpm), 4-pole (1800 rpm) or 6-pole (1200 rpm) motors, NEMA Design B, with Class B insulation capable to operate continuously at 104 deg F (40 deg C) without tripping overloads.

6. Motors shall have a +/- 10 percent voltage utilization range to protect against voltage variation.

7. V-Belt Drive shall be fixed pitch rated at 1.5 times the motor nameplate. Drives 20 hp and larger or any drives on units equipped with VFDs shall be fixed pitch.

8. Manufacturer shall provide for each belt driven fan a nameplate with the following information to assist air balance contractor in start up and service personnel in maintenance:

a. Fan and motor sheave part number

b. Fan and motor bushing part number

c. Number of belts and belt part numbers

d. Fan design RPM and motor HP

e. Belt tension and deflection

f. Center distance between shafts

2.08 COILS

A. Coils section header end panel shall be removable to allow for removal and replacement of coils without impacting the structural integrity of the unit.

B. Install coils such that headers and return bends are enclosed by unit casing to ensure that if condensate forms on the header or return bends, it is captured by the drain pan under the coil.

C. Coils shall be manufactured with plate fins to minimize water carryover and maximize airside thermal efficiency. Fin tube holes shall have drawn and belled collars to maintain consistent fin spacing to ensure performance and air pressure drop across the coil as scheduled. Tubes shall be mechanically expanded and bonded to fin collars for maximum thermal conductivity. Use of soldering or tinning during the fin-to-tube bonding process is not acceptable due to the inherent thermal stress and possible loss of bonding at that joint. Heating and cooling coil tubing to have 0.035" minimum wall thickness and 0.625" diameter.

D. Construct heating coil casings of galvanized steel. Construct cooling coil casing of stainless steel. End supports and tube sheets shall have belled tube holes to minimize wear of the tube wall during thermal expansion and contraction of the tube.

E. All coils shall be completely cleaned prior to installation into the air handling unit. Complete fin bundle in direction of airflow shall be degreased and steam cleaned to remove any lubricants used in the manufacturing of the fins, or dirt that may have accumulated, in order to minimize the chance for water carryover.

F. When two or more cooling coils are stacked in the unit, an intermediate drain pan shall be installed between each coil. The intermediate drain pan shall be designed being of sufficient size to collect all condensation produced from the coil and sloped to promote positive drainage to eliminate stagnant water conditions. The intermediate drain pan shall be constructed of the same material as the sections primary drain pan.

G. The intermediate drain pan shall begin at the leading face of the water-producing device and be of sufficient length extending downstream to prevent condensate from passing through the air stream of the lower coil.

H. Intermediate drain pan shall include downspouts to direct condensate to the primary drain pan. The intermediate drain pan outlet shall be located at the lowest point of the pan and shall be sufficient diameter to preclude drain pan overflow under any normally expected operating condition.

I. Electric Coil

1. Electric heat shall be factory installed in the air handler and shipped complete to the job site. For blow-thru applications, a diffuser plate shall be installed between the supply fan and electric heater. The complete air handler shall be UL/CUL or ETL listed as shipped from the manufacturer. If the air handler is not UL/CUL or ETL listed with an electric heater, the contractor is responsible for expenses associated with field inspection and licensing to UL/CUL or ETL.

2. Construction

   a. The heater shall be an open-coil configuration with Type A wire (80% nickel and 20% chromium) derated to a maximum watt density of 45 watts per square inch. Safeties shall include three-pole, disconnecting-type contactors,airflow proving switch to ensure airflow through the heater, an automatic reset high temperature limit and a manual reset high temperature limit to ensure safe operating temperatures of the heater. The contactors for energizing the electric heater shall be magnetic contactors. Electric heaters above 48 amps shall be fused into circuits not to exceed 48 amps as required by UL and NEC. Kilowatt output shall be selected to the nearest 0.1 kW of scheduled kilowatt.
   b. Resistance wire shall be mechanically staked and heliarc welded to corrosion resistant terminals to ensure maximum reliability and minimum electrical resistance. Heating elements shall be supported by corrosion resistant heavy gauge wire rack construction. The design should feature free airflow around ceramics and the lowest possible pressure drop through elements and rack. The heater shall use high quality anti-thermal shock, moisture resistant steatite ceramics and 105 degree C rated appliance wire.
   c. Voltage shall be as shown on the schedule.
   d. Electric heat stages of control shall be as defined in unit plans. Amperage shall not exceed 48 amps per stage.
   e. Control of electric heater shall be by a step controller. Step controller shall be capable of providing electronic sequencing control of electric heater. The step controller shall accept a 0-10VDC, 4-20mA, or 0-135 ohm control signal from the unit controller.
   f. Detailed wiring diagrams shall be provided inside each electric heater control panel for installation wiring connections and service requirements.

2.09 FILTERS

A. Provide factory-fabricated filter section of the same construction and finish as unit casings. Filter section shall have side access filter guides and access door(s) extending the full height of the casing to facilitate filter removal. Construct doors in accordance with Section 2.04. Provide fixed filter blockoffs as required to prevent air bypass around filters. Blockoffs shall not need to be removed during filter replacement. Filters to be of size, and quantity needed to maximize filter face area of each particular unit size.

B. Filters shall be MERV 13

C. Manufacturer shall provide one set of startup filters and one set of spare filters.

2.10 DAMPERS

A. All dampers, with the exception of external bypass and multizones (if scheduled), shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D. Manufacturer shall submit brand and model of damper(s) being furnished, if not Ruskin CD60.

B. Dampers shall be provided for outside air, return air, exhaust air, and energy recovery wheel bypass (where present).

2.11 DUAL PATH AIR HANDLING UNITS

A. The outside air section cooling coil shall be sized per the schedule to accommodate peak and part-load humidity control.

2.12 FACTORY-ENGINEERED AUTOMATIC TEMPERATURE CONTROLS

A. Unit shall be provided with a factory wired, installed and tested unit controller, capable of standalone unit control, or tied into a building automation system through Bacnet communication. All control points in unit shall be tested at the unit manufacturers facility prior to shipment.

PART 3 EXECUTION

3.01 SHIPPING

A. Paper copies of the IOM shall also be shipped with each AHU.

B. The AHU manufacturer shall identify all shipments with the order number. Enough information shall be provided with each shipment to enable the Mechanical Contractor to confirm the receipt of units when they are received. For parts too small to mark individually, the AHU manufacturer shall place them in containers.

C. To protect equipment during shipment and delivery, all indoor units shall be completely stretch or shrink wrapped. Wrap shall be a minimum of 7 mil plastic. Pipe ends and pipe connection holes in the casing shall be capped or plugged prior to shipment

D. After loading the equipment for shipment, the AHU manufacturer shall contact the shipping contact on the order and provide the name of the carrier, description of equipment, order number, shipping point, and date of shipment.

3.02 ON-SITE STORAGE

A. If equipment is to be stored for a period of time prior to installation, the Mechanical Contractor shall remove all stretch or shrink wrap from units upon receipt to prevent unit corrosion and shall either place the units in a controlled indoor environment or shall cover the units with canvas tarps and place them in a well-drained area. Covering units with plastic tarps

shall not be acceptable.

3.03 FIELD EXAMINATION

A. The Mechanical Contractor shall verify that the mechanical room and/or roof are ready to receive work and the opening dimensions are as indicated on the shop drawings and contract documents.

B. The Mechanical Contractor shall verify that the proper power supply is available prior to starting of the fans.

3.04 INSTALLATION

A. The Mechanical Contractor shall be responsible to coordinate ALL of his installation requirements with the Owner and the Owner¿s selected Mechanical Contractor to ensure that a complete installation for each unit is being provided. Coordination efforts shall include such items as unloading and hoisting requirements, field wiring requirements, field piping requirements, field ductwork requirements, requirements for assembly of field-bolted or welded joints, and all other installation and assembly requirements.

B. The AHU manufacturer shall provide all screws and gaskets for joining of sections in the field.

C. The Mechanical Contractor shall verify that the following items have been completed prior to scheduling the AHU manufacturer's final inspection and start up:

1. All spring-isolated components have had their shipping restraints removed and the components have been leveled.

2. On all field-joined units, that all interconnections have been completed, i.e., electrical and control wiring, piping, casing joints, bolting, welding, etc.

3. All water and steam piping connections have been completed and hydrostatically tested and all water flow rates have been set in accordance with the capacities scheduled on the Drawings.

4. All ductwork connections have been completed and all ductwork has been pressure tested for its intended service.

5. All power wiring, including motor starters and disconnects, serving the unit has been completed.

6. All automatic temperature and safety controls have been completed.

7. All dampers are fully operational.

8. All shipping materials have been removed.

9. All (clean) filter media has been installed in the units.

3.05 LEVELING

A. The Mechanical Contractor shall level all unit sections in accordance with the unit manufacturer’s instructions. The Mechanical Contractor shall provide and install all necessary permanent shim material to ensure individual sections and entire assembled units are level.

3.06 FINAL INSPECTION AND START UP SERVICE

A. After the Mechanical Contractor has provided all water and steam piping connections, ductwork connections, and field control wiring, and Electrical Contractor has provided all the field power wiring, the Mechanical Contractor shall inspect the installation. The Mechanical Contractor shall then perform startup of the equipment.

B. The Automatic Temperature Control (Building Direct Digital Control) Contractor shall be scheduled to be at the job site at the time of the equipment start up.

C. The Mechanical Contractor, shall perform the following tests and services and submit a report outlining the results:

1. Record date, time, and person(s) performing service.

2. Lubricate all moving parts.

3. Check all motor and starter power lugs and tighten as required.

4. Verify all electrical power connections.

5. Conduct a start up inspection per the AHU manufacturer's recommendations.

6. Record fan motor voltage and amperage readings.

7. Check fan rotation and spin wheel to verify that rotation is free and does not rub or bind.

8. Check fan for excessive vibration.

9. Check V belt drive or coupling for proper alignment.

10. Check V belt drive for proper tension. Tighten the belts in accordance with the AHU manufacturer's directions. Check belt tension during the second and seventh day's operation and re-adjust belts, as may be required, to maintain proper tension as directed by the AHU manufacturer.

11. Remove all foreign loose material in ductwork leading to and from the fan and in the fan itself.

12. Disengage all shipping fasteners on vibration isolation equipment.

13. Check safety guards to insure they are properly secured.

14. Secure all access doors to the fan, the unit and the ductwork.

15. Switch electrical supply "on" and allow fan to reach full speed.

16. Physically check each fan at start up and shut down to insure no abnormal or problem conditions exist.

17. Check entering and leaving air temperatures (dry bulb and wet bulb) and simultaneously record entering and leaving chilled water temperatures and flow, steam pressures and flow, and outside air temperature.

18. Check all control sequences.

END OF SECTION 237313

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SECTION 237433 - DEDICATED OUTDOOR-AIR AND MAKE-UP 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 factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment 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. Prepare the following by or under the supervision of a qualified professional engineer:

    a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
    b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting 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. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.

2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

B. Seismic Qualification Certificates: For dedicated outdoor-air units, 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. 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. Startup service reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For 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. Fan Belts: One set[s] for each belt-driven fan.
2. Filters: One set[s] for each unit.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five years from date of Substantial Completion.
2. Warranty Period for Heat Exchangers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AAON.

2. Trane

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Cabinet Thermal Performance:

1. Maximum Overall U-Value: Comply with requirements in ASHRAE/IESNA 90.1.
2. Maximum Overall U-Value: 0.10 Btu/h x sq. ft. x deg F.
3. Include effects of metal-to-metal contact and thermal bridges in the calculations.

C. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

D. Maximum Cabinet Leakage: 1 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.

E. Cabinet Deflection Performance:

1. Walls and roof deflection shall be within 1/240 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
2. Floor deflections shall be within 1/240 of the span considering the worst-case condition caused by the following:

a. Service personnel.
b. Internal components.
c. Design working pressure defined for the walls and roof.

F. 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.

G. Capacities and Characteristics:

1. Refer to mechanical schedule.

2. Refrigerant Cooling:
   a. Full-Load Efficiency (EER or COP): Refer to mechanical schedule
   b. Condenser Ambient-Air Temperature: 95 deg F

3. Gas-Fired Furnace Heating:
   a. Efficiency: 80 percent.
   b. Fuel: Natural gas.

4. Overall Unit Electrical Characteristics:

a. Volts: 208
b. Phase: Three
c. Hertz: 60.

2.3 CABINET

A. Construction: double wall.

1. Exterior casing Material: Galvanized steel with paint finish. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

B. Interior Casing Material: Galvanized steel.

C. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

D. Base Rails: Galvanized-steel rails for mounting on roof curb or pad as indicated.

E. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.

F. Roof: Standing seam or membrane; sloped to drain water.

G. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.

H. Cabinet Insulation:

1. Type: Polyurethane foam
2. Thickness: 2 inch
3. Minimum thermal resistance valve of R-13

I. Condensate Drain Pans:

1. Shape: Rectangular, with 1 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.

a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1
b. Depth: A minimum of 2 inches deep.

3. Configuration: Single wall.
4. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.

5. Material: Galvanized-steel sheet with asphaltic waterproofing compound coating on pan top surface.
6. Material: Stainless-steel sheet.
7. Drain Connection:

    a. Located on one end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
    c. Minimum Connection Size: NPS 1

8. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

J. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

K. Roof Curb: Full-perimeter curb of sheet metal, minimum 16 inches high, with wood nailer, neoprene sealing strip, and welded Z-bar flashing.

1. Comply with requirements in "The NRCA Roofing Manual."

2.4 SUPPLY FAN

A. Plenum Fan Type: Single width, non-overloading, with backward-inclined or airfoil blades.

1. Fan Wheel Material: Aluminum; attached directly to motor shaft.
2. Fan Wheel Drive and Arrangement: Direct drive, AMCA Arrangement 4.
3. Fan panel and frame Material: Powder-coated steel, stainless steel, or aluminum.
4. Fan Enclosure: Easily removable enclosure around rotating parts.
5. Fan Balance: Blower and motor shall be dynamically balanced at the factory.

B. Motors:

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Enclosure: Totally enclosed
3. Enclosure Materials: Cast aluminum Motor Bearings

4. Efficiency: Premium efficient.
5. Service Factor: 1.15

2.5 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater.

D. Refrigerant: R-454B

1. Classified as Safety Group A2L according to ASHRAE 34.
2. Provide unit with operating charge of refrigerant.

E. Refrigeration System Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant dryer.
3. High-pressure switch.
4. Low-pressure switch.
5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
6. Brass service valves installed in discharge and liquid lines.

F. Capacity Control:

1. Variable capacity digital scroll compressor capable of modulation from 10%-100% capacity.
2. Provide hot gas reheat coil with modulating valve to provide reheat for humidity control.

G. Refrigerant condenser and reheat condenser coils:

1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
2. Tube Material: Copper.
3. Fin Material: Copper.
4. Fin and Tube Joint: Mechanical bond.
5. Leak Test: Coils shall be leak tested with air underwater.

H. Condenser Fan Assembly:

1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
2. Fan 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."
    b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
    c. Enclosure Materials: Cast aluminum
    d. Motor Bearings: Permanently lubricated bearings

    e. Built-in overcurrent and thermal-overload protection.
    f. Efficiency: Premium efficient or electronically commutated.
    g. Service Factor: 1.1

3. Fan Safety Guards: Steel with corrosion-resistant coating.

I. Safety Controls:

1. Compressor motor and condenser coil fan motor low ambient lockout.
2. Overcurrent protection for compressor motor.

2.6 INDIRECT-FIRED GAS FURNACE HEATING

A. Furnace Assembly:

1. Factory assembled, piped, and wired.
2. Comply with requirements in NFPA 54, "National Fuel Gas Code," and ANSI Z21.47, "Gas-Fired Central Furnaces."
3. AGA Approval: Designed and certified by and bearing label of AGA.

B. Burners:

1. Heat-Exchanger Material: Stainless steel with a minimum thermal efficiency of 80 percent.
2. Fuel: Natural gas.
3. Ignition: Electronically controlled electric spark with flame sensor.

C. Heat-Exchanger Drain Pan Material: Stainless steel.

D. Venting: Gravity vented.

E. Venting: Power vent with integral, motorized centrifugal fan interlocked with gas valve.

F. Safety Controls:

1. Gas Control Valve: Electronic modulating.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.7 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.

2.8 AIR-TO-AIR ENERGY RECOVERY (REFER TO SCHEDULE)

A. Heat Wheels:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Aaon.

b. Trane; American Standard Inc.

2. Casing:

a. Steel, with manufacturer's standard paint coating.
b. Casing seals on periphery of rotor, on duct divider.
c. Support rotor on grease-lubricated ball bearings with extended grease fittings. Mount horizontal wheels on tapered roller bearing.

3. Rotor: Continuously wound with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop to efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self supporting matrix
4. Drive: Fractional horsepower motor and gear reducer, and self-adjusting multilink belt around outside of rotor.

2.9 FILTERS

A. Cleanable Filters: 2-inch- (50-mm-) thick, cleanable metal mesh.

B. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.
2. Factory-fabricated, dry, extended-surface type.
3. Thickness: 2 inches
4. Minimum Merv: 8>, according to ASHRAE 52.2.
5. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

C. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Extended surface filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks with space for prefilter.

2.10 ELECTRICAL POWER CONNECTIONS

A. General Electrical Power Connection Requirements: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.

B. Enclosure: NEMA 250, Type 4, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key,

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
2. NEMA KS 1, heavy-duty, nonfusible switch.
3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

J. Lights: Factory wire unit-mounted lights.

K. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.

L. Control Relays: Auxiliary and adjustable time-delay relays.

2.11 VIBRATION CURBS

A. Manufacturers:
1. Pate
2. Roof Products, Inc.
3. Thybar Corp.

B. Materials: 18-gauge galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

a. Materials: ASTM C 1071, Type I or II.
b. Thickness: 1-1/2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.

a. Liner Adhesive: Comply with ASTM C 916, Type I.
b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.

C. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The 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. Adjustable, restrained-spring isolators shall be mounted on 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.

D. Curb Height: Height may vary per RTU based on manufacturer's recommendation. Submit curb to ERO for approval.

2.12 CONTROLS

A. Control Wiring: Factory wire connection for controls' power supply.

B. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

C. Remote-Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
3. Status Lights:

    a. Filter dirty.
    b. Fan operating.
    c. Cooling operating.
    d. Heating operating.
    e. Smoke alarm.
    f. General alarm.

4. Digital Numeric Display:

    a. Outdoor airflow.
    b. Supply airflow.
    c. Outdoor dry-bulb temperature.
    d. Outdoor dew point temperature.
    e. Space temperature.
    f. Supply temperature.
    g. Space relative humidity.
    h. Space carbon dioxide level.

D. Control Dampers:

1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. (33 L/s per sq. m) at a static-pressure differential of 4.0 inches water

column (1000 Pa) when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.

3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service and use modulating control when mixing two airstreams. For other applications, use an opposed-blade configuration.
6. Damper Frame Material: Extruded aluminum.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves
8. Blade Material: Extruded aluminum
9. Maximum Blade Width: 6 inches
10. Maximum Blade Length: 48 inches
11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. Airflow Measurement:

    a. Monitoring System: Complete and functioning system of airflow monitoring as an integral part of the damper assembly where indicated.
    b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
    c. Accuracy of flow measurement: Within [5] [10] <Insert value> percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
    d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
    e. flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

E. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 90 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

F. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F.
3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

G. Furnace Controls:

1. Factory-mounted sensor in supply outlet with sensor adjustment located in control panel to modulate gas furnace burner to maintain space temperature.
2. Remote Setback: Adjustable room thermostat selected by timer, set at 50 deg F cycles supply fan and gas furnace burner to maintain space temperature.
3. Staged Burner Control: Modulating
4. Electromechanical or Electronic Burner Control: 20 to 100 percent modulation of the firing rate; 10 to 100 percent with dual-furnace units.

H. Damper Controls: Space pressure sensor modulates outdoor- and return-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg with respect to outdoor reference.

I. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230900 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:

    a. Discharge-air temperature.
    b. Refrigeration system operating.
    c. Furnace operating.
    d. Constant and variable motor loads.
    e. Variable-frequency-controller operation.
    f. Return-air temperature
    g. Return-air humidity
    h. Cooling load.
    i. Economizer cycles.
    j. Air-distribution static pressure and ventilation-air volumes.

J. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.

1. Hardwired Points:

    a. Monitoring: On-off status, common trouble alarm
    b. Control: On-off operation, space humidity set-point adjustment

2. ASHRAE 135 BACnet communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator

workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

2.13 ACCESSORIES

A. Service Lights and Switch: Factory installed in fan and coil sections > with weatherproof cover. Factory wire lights to a single-point field connection.

B. Duplex Receptacle: Factory mounted in unit supply-fan section and refrigeration section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, 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. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."

1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Restrained Curb Support: Install restrained vibration isolation roof-curb rails on roof structure according to "The NRCA Roofing Manual."

D. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

F. Install 3000-psi, compressive-strength (28-day) concrete base inside roof curb, 4 inches thick. Concrete and reinforcement are specified with concrete.

G. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."

H. Install separate devices furnished by manufacturer and not factory installed.

I. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

J. Install drain pipes from unit drain pans to sanitary drain.

1. Drain Piping: Drawn-temper copper water tubing complying with ASTM B 88, Type L, with soldered joints.
2. Drain Piping: Schedule 40 PVC pipe complying with ASTM D 1785, with solvent-welded fittings.

    a. 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).
    b. 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).
    c. Solvent cement and 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."

3. Pipe Size: Same size as condensate drain pan connection.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Gas Piping Connections:

1. Comply with requirements in Section 231123 "Facility Natural-Gas Piping."
2. Connect gas piping to furnace, full size of gas train inlet, and connect with union[, pressure regulator,] and shutoff valve with sufficient clearance for burner removal and service.
3. Install AGA-approved flexible connectors.

C. Duct Connections:

1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.

1. Install electrical devices furnished by unit manufacturer but not factory mounted.

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. Inspect units for visible damage to furnace combustion chamber.
3. 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 flue-gas temperature at furnace discharge.
    d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

    a. High-limit heat exchanger.
    b. Alarms.

5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:

    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.

7. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

8. Inspect casing insulation for integrity, moisture content, and adhesion.
9. Verify that clearances have been provided for servicing.
10. Verify that controls are connected and operable.
11. Verify that filters are installed.
12. Clean coils and inspect for construction debris.
13. Clean furnace flue and inspect for construction debris.

14. Inspect operation of power vents.
15. Purge gas line.
16. Inspect and adjust vibration isolators and seismic restraints.
17. Verify bearing lubrication.
18. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
19. Adjust fan belts to proper alignment and tension.
20. Start unit.
21. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
22. Operate unit for run-in period.
23. Calibrate controls.
24. Adjust and inspect high-temperature limits.
25. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
26. Verify operational sequence of controls.
27. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Return-air flow.
    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity 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.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 237433

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SECTION 238219 - FAN COIL UNITS

A. MANUFACTURERS

1. Basis of Design: Trane

B. GENERAL

1. Furnish and install Direct Drive Fan and Blower Coil Units where indicated on the plans and in the specifications.
2. Units shall be completely factory assembled, tested and shipped as one piece.
3. Units shall be capable of meeting or exceeding the scheduled capacities for cooling, heating and air delivery. Unit dimensions for each model and size shall be considered maximums.
4. Units shall be cETLus listed in compliance with UL/ANSI Standard 1995, and be certified as complying with the latest edition of AHRI Standard 440.

C. CONSTRUCTION

1. Unit chassis shall be fabricated of galvanized steel panels.
2. Exterior panels shall be insulated with 3/8" thick elastomeric closed cell foam Insulation. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire and smoke, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723. Additionally, insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene insulation is not acceptable.
3. Ducted units shall have a minimum 1-1/2" duct collar on the discharge. Plenum and exposed units shall have a minimum 3/4" duct collar on the return.
4. Exposed units shall have exterior panels fabricated of galvannealed steel. The fan and filter bottom access panel shall be attached with quarter turn quick open fasteners to allow for easy removal and access for service.
5. Unit mounting shall be by hanger brackets provided at four locations.
6. Hanger brackets to include rubber isolators
7. Floor Mounted Units
    a. Non-ducted air inlets and outlets shall be provided with linear bar grilles
    b. Provide end pockets on both ends of fan coil
    c. Provide plenum falseback and sub-base

D. PAINTED FINISH

1. Painted cabinet exterior panels shall be finished with a heat cured anodic acrylic powder paint in color selected by architect.

E. SOUND

1. Ducted units shall have published sound power level data tested in accordance with AHRI Standard 260-2012.
2. Exposed units shall have published sound power level data tested in accordance with AHRI Standard 350-2015 (non-ducted equipment).

F. FAN ASSEMBLY

1. Unit fan shall be a dynamically balanced, forwardly curved, DWDI centrifugal type constructed of 18 gauge zinc coated galvanized steel for corrosion resistance. Motors shall be high efficiency, permanently lubricated sleeve bearing, permanent split-capacitor type with UL and CSA listed automatic reset thermal overload protection and three separate horsepower taps. Single speed motors are not acceptable.
2. The fan assembly shall be easily removable for servicing the motor and blower at, or away from the unit. The entire fan assembly shall be able to come out of the unit by removing two screws and unplugging the motor. Plenum unit fan assemblies shall be easily serviced through an access panel in casing.
3. Devices used to energize and de-energize (switch) fan speeds must be silent. Magnetic, mercury, and/or quiet relays and/or contactors are not acceptable.
4. Motor shall be capable of accepting a 2-10 VDC output from BAS.
5. Provide an electronic (SCR) fan speed controller as an aid in balancing the fan capacity. The speed controller shall have a turn down stop to prevent the possibility of harming the motor bearings, and incorporate electrical noise suppression to minimize noise on the incoming power lines.

G. COILS

1. All cooling and heating coils shall optimize rows and fins per inch to meet the specified capacity. Coils shall have seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and fin. Fins shall have high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.
2. Each coil shall be pressured to 450 PSIG and rated for a maximum of 450 PSIG working pressure.
3. Coil casing shall be fabricated from Stainless Steel. All coils shall be provided with a manual air vent fitting to allow for coil venting.
4. Coils shall have ½” x 0.025” copper tubes.
5. Heating coils shall be furnished in the preheat position on units with chilled water coils, or in the reheat position for DX coils.

H. DRAIN PANS

1. Provide a single wall primary drain pan constructed entirely of heavy gauge stainless steel for superior corrosion resistance. Stainless steel drain pans shall be externally insulated.
2. Drain pans shall be of one-piece construction and be double sloped for condensate removal.
3. Drain pans shall be fully removable without the use of any tools.
4. The drain pan shall be externally insulated with a fire retardant, closed cell foam insulation. The insulation shall carry no more than a 25/50 Flame Spread and Smoke Developed Rating per

ASTM E-84 and UL 723 and an Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21.

5. Provide a secondary drain connection on the primary drain pan for condensate overflow.
6. Factory installed condensate overflow switch

I. FILTERS

1. All plenum and exposed units shall be furnished with a minimum 1" nominal glass fiber throwaway filter. Filters shall be tight fitting to prevent air bypass. Plenum unit filters shall be easily removable from the bottom of the unit without the need for tools.
2. Provide unit with 1" pleated filter (MERV 13).

J. ELECTRICAL

1. Units shall be furnished with single point power connection. Provide an electrical junction box with terminal strip for motor and other electrical terminations.
2. Discharge air temperature sensor, fan status, high condensate switch, and freezestat shall be factory wired to terminal strip.

K. DEMONSTRATION

Train owner’s personnel to operate and maintain equipment.

L. WARRANTY

2 years from substantial completion.

END OF SECTION 238219

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SECTION 238223 – UNIT VENTILATORS

PART 1 GENERAL

1.01 Summary

A. Section Includes:

1. Unit ventilators.

a. Hydronic coils

b. Hydronic and Steam coil.

c. Direct-expansion refrigerant cooling coil and Hydronic reheat coil.

d. Direct-expansion refrigerant cooling coil and Electric reheat coil.

B. Related Requirements:

1.02 References

A. ANSI/NFPA 70 - National Electric Code.

B. AHRI 840, "Unit Ventilators"

C. AHRI 440, "Room Fan Coil and Unit Ventilator"

D. ASHRAE 62, "Ventilation for Acceptable Indoor Air Quality"

E. AHRI 350-- Standard for Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment.

F. Note: non-ducted vertical fan coil units will be substantially similar to unit ventilators.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product

B. Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.

C. 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. Detail anchorages and attachments to structure and to supported equipment.

4. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 Informational Submittals

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with other trades

B. Seismic Qualification Certificates: For unit ventilators, accessories, and components, from manufacturer.

C. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

D. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

E. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.05 Closeout Submittals

A. Operation and Maintenance Data: For unit ventilators to include in emergency, operation, and maintenance manuals.

B. Manufacture provided start-up report.

C. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

D. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.06 Maintenance Material Submittal

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Unit Ventilator Filters: Furnish one spare filter(s) for each filter installed.

1.07 Coordination

A. Coordinate layout and installation of unit ventilators 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.

B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.08 Warranty

A. The equipment purchaser shall be provided, at no additional cost, a standard parts warranty that covers a period of 24 months from start-up. This warrants that all products are free from defects in material and workmanship and have capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

B. Blow-through unit ventilators are the basis of design. Draw-through unit ventilators shall be supplied with a face and bypass damper and a 5 year parts and labor warranty covering coil freeze-ups. A warranty letter and bid shall be submitted by the contractor.

1.09 Regulatory Requirements

A. Manufacturers must participate in the AHRI Certification program. Unit performance data must be rated and certified in accordance with AHRI Standard 440, and must display the AHRI Symbol on all standard units. If a manufacturer does not participate in the AHRI Certification program, specified equipment engineer shall select a representative sample that must be witnessed tested at the manufacturers expense by the engineer to meet the criteria of the specification.

B. Conform to UL1995 for internal wiring of factory-wired equipment.

PART 2 PRODUCTS

2.01 General

A. MANUFACTURERS - UNIT VENTILATORS

1. Acceptable Manufacturers

a. Trane

b. MagicAire

c. Daikin

B. Unit Construction

1. The cabinets shall be constructed of 16-gauge zinc-coated steel. All steel surfaces are cleaned, phosphatized, rinsed, and dried before application of final finish paint. The paint shall be applied by an electrostatic powder spray system. The paint shall result in an appliance-grade finish.

2. Cabinet end pockets shall be a minimum of 12 inches wide to facilitate piping and service. If less than 12 inches, unit manufacturer shall provide an extended cabinet or piping enclosure.

C. Floor-Mounted Unit Ventilators

1. Floor-mounted units shall have an integral pipe tunnel for convenient crossover of piping or electrical wiring. The front surface shall consist of one removable panel for quick removal.

2. The unit discharge grille shall be of a double deflection type to throw air in two directions.

3. To prevent entry of small objects into the fan, provide a discharge grille screen for fans located in the line of sight.

4. Units shall have four adjustable leg levelers.

5. End panels shall be factory-installed on the unit.

6. Provide plenum falseback and sub-base.

7. Provide linear bar grilles on air inlets and outlets

D. Ceiling-Mounted Unit Ventilators

1. Ceiling-mounted units shall be constructed with 2 hinged bottom panels for ease of maintenance. Access to filters, controls, and piping shall be easily available through the two bottom panels. All components of the fan/motor assembly must be removable from the bottom of the unit.

2. The discharge opening of the unit shall be fitted with a bar grille as shown on the plans.

3. Recessed units shall be furnished with a trim flange.

4. Units shall have end panels factory installed.

5. Units shall be finished in one of five baked enamel finishes to be selected by the architect.

6. Provide spring vibration isolators.

7. Provide linear bar grilles on air inlets and outlets

E. Fan Board and Motor

1. For quick maintenance, the fan board assembly shall be a single, rigid assembly including fans, fan housing, bearing, and fan shaft.

2. Fan/coil arrangement shall be blow-through design to eliminate debris from falling into the spinning fan. This safety consideration helps prevent personal injury, noise, or equipment damage. The blow-through design shall protect the coil from freezing by placing the coil farther away from the inlet and mixing the room air and fresh air before it blows across the coil. The coil shall be placed near the discharge opening in order to attenuate fan noise. Units with a draw-through design must provide a discharge grille screen and a face & bypass damper to protect fans in the line of sight.

3. Provide quick connects for the fan motor for easy maintenance and removal.

4. Motor: All motors shall be Brushless DC (BLDC)/Electronically Commutated Motors (ECM) factory programmed and run tested in assembled units.

   a. The motor controller shall be mounted in a touch-safe control box with a built in integrated user interface and LED tachometer.
   b. If adjustments are needs, motor parameters shall be adjustments through momentary contact switches accessible without factory service personnel on the motor control board.
   c. Motors shall have a soft ramp between speeds to lessen the acoustics due to sudden speed changes.
   d. Motors shall be operated at three speeds or with variable speed. The motor will choose the highest speed if there are simultaneous/conflicting speed requests.
   e. All motors shall have integral thermal overload protection with a maximum ambient operating temperature of 104F and are permanently lubricated.
   f. Motors shall be capable of starting at 50 percent of rated voltage and operating at 90 percent of rated voltage on all speed settings.
   g. Motors shall be capable of starting at 50 percent of rated voltage and operating at 90 percent of rated voltage on all speed settings.

F. Fresh Air and Room Air Dampers

1. The unit shall be equipped with a dual-blade mixing damper with a compressible seal to ensure proper modulation and mixing of the room air and fresh air.

2. The damper shall be capable of varying the proportion of mixed air from 100 percent room air to 100 percent fresh air.

3. Provide an ultra-low leak damper seal made of closed cell EPDM material. Leakage shall be less than 1 percent against 0.5 inches of external static pressure.

4. Damper shall contain a continuous divider placed between the damper blades to separate the fresh air and room air compartments to prevent blow-through.

G. Ventilation Performance

1. Unit manufacturer shall provide airflow performance data by specific option and size per AHRI 840-98. If the manufacturer cannot provide AHRI 840 certified airflow data they must provide, at their expense, certified, independent, balancing reports verifying compliance with AHRI 840. These reports shall be submitted to the mechanical engineer for approval.

H. Drain Pan

1. The drain pan shall be easily removable for cleaning.

2. Unit drain pans are to be positively sloped internal or external to the unit.

3. A drain outlet shall be provided on both ends of the pan with one outlet capped. The drain hand connection shall be easily field-reversed by relocating the cap to the opposite end.

4. The drain pan shall be constructed of smooth, corrosion resistant material. The bottom of the drain pan shall be sloped in two planes that pitch the condensate to the drain connection. Stainless steel drain pans shall be provided as an equal to polymer resin drain pans.

5. The condensate drain shall be internally or externally trapped via accepted ASHRAE guidelines.

I. Coils

1. Coils shall be selected in accordance with AHRI 440.

2. Hydronic Coils

   a. Hydronic coils shall be constructed with copper tubes and mechanically bonded aluminum corrugated plate fins. All coils shall have aluminum individual unshared fin surfaces.
   b. A threaded drain plug shall be furnished at the lowest point of the coil.
   c. A manual air vent shall be provided at the highest point of the coil.

3. Steam coils shall be double tube, steam distributing freeze-resistant type. Provide face and bypass on all steam units.

4. Direct Expansion Coils

   a. All DX coils must be supplied with a factory-installed thermal expansion valve sized for the manufacturer's matching remote-condensing unit.
   b. A DX low temperature limit sensor shall be provided.
   c. A 24V transformer shall be provided to power the remote-condensing unit.
   d. Refrigerant access ports shall be factory-supplied on the high and low side for

easy refrigerant pressure or temperature testing.

5. Electric Heat Coils

   a. Units equipped for electric heat shall have a heating element consisting of special resistance elements inserted in an extended surface fin-tube bundle for maximum element life and safety.
   b. The coil shall include a high temperature cutout with a continuous sensing element. This device interrupts power whenever excessive temperatures are sensed anywhere along the leaving side of the coil. A contactor shall also be included to ensure positive disconnect of electrical power whenever fan motor power is interrupted.
   c. A dead front switch to disconnect power when the access panel is opened shall be provided by the manufacturer.
   d. All electric heat units shall have a power-wiring console in the right hand end pocket to facilitate field wiring of the unit.
   e. Provide 1 or 2 stages of control from factory.
   f. Unit will require a neutral and a common wire.

J. Filters: Each unit shall be equipped with a single 1-inch thick, MERV 8 filter accessible without the removal of the unit front panel.

K. Underwriters Laboratory: Unit Ventilators shall be listed by Underwriters Laboratory, Inc. for the United States and Canada.

PART 3 EXECUTION

3.01 Installation

A. Furnish and install where shown on plans, a complete unit ventilator with capacities, airflow, and configuration as listed on unit schedule.

PART 4 DEMONSTRATION

Train owner’s personnel to operate and maintain equipment.

END OF SECTION 238223

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SECTION 238233 – CONVECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hydronic radiant panel radiators

2. Hydronic fin tube radiators

1.2 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.

B. Color Samples for Initial Selection: For units with factory-applied color finishes.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 HYDRONIC RADIANT PANEL RADIATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Zehnder Rittling Corporation.
2. Runtal North America

B. Performance Ratings: Rate radiators according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

C. Radiators are medium pressure construction (85 psi max, tested at 110 psi) manufactured of cold rolled low carbon steel, fully welded and consisting of header pipes at each end, connected by flat oval water tubes.

D. Provide steel panel radiator elements of lengths and in locations as indicated on the plans and equipment schedule. The wall hung heating panel radiation shall be of one-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. The radiator shall include an integral heavy 11-gauge all-welded perforated top grille. Models to have steel corrugated fins welded to the active water tubes to increase the convective output of the unit. There shall be no less than 32 fins per foot. Fins shall start within 1" of the headers, and shall be spot-welded three times per tube. In addition, there shall be an inactive set of tubes on the front side of the TT Model and the RF Models will have an inactive front panel shipped loose for attachment.

E. Radiator header pipes are square 0.109" min. wall thickness and include all necessary supply, return, and air vent connections. Internal baffling is provided as required.

F. Piping connections are ½" NPT taper threaded sockets, located in either side, or vertical positions. Air vent connections are 1/8" NPT taper threaded sockets.

G. Radiator expansion does not exceed 0.016 inch per linear foot at 215F. Expansion compensation to be provided in the piping as required by the installing contractor.

H. Radiators shall be phosphatized and primed with flat white baked enamel.

I. Radiators shall be finish painted with gloss baked enamel, for a total paint thickness of 2 to 3 mils.

J. Color of the finish paint shall be selected by the architect from the manufacturer's full range of colors, including custom colors.

K. Top and bottom wall mounting brackets are provided with radiators.

L. Provide 12" valve concealment sections, end trims, and trims between sections as required for a complete installation.

2.2 HYDRONIC FIN TUBE RADIATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Zehnder Rittling Corporation.
2. Runtal North America

B. Performance Ratings: Rate radiators according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on polypropylene element glides. One end of tube shall be belled.

D. Enclosures: 14-gauge cold rolled steel. All enclosures shall be reinforced with a (minimum of two) gussets welded at ends of each enclosure style. The joining of enclosure shall be accomplished by use of internal joggle joiners providing added rigidity and alignment with

adjoining enclosures. No sheet metal screws or other fastening devices shall be visible. Enclosures will be provided from 1ft to 8 ft lengths in 6" increments. The upper portion of the enclosure will be secured in a hinge type manner by use of a full length roll formed mounting channel or full back panel, while the lower portion of the enclosure will be secured to steel snap expansion brackets by use of a positive locking, bottom mounting clip using fasteners thus preventing removal without tools.

E. Grilles: Aluminum discharge grilles to be one continuous length with clear anodized finish with a 15-degree deflection and be a “pencil proof” design.

F. Finish: All enclosures and accessories shall be degreased and chemically phosphatized before application of a durable electrostatic epoxy powder coating. Color to be selected from manufacturer’s full range of colors, including custom colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before convection heating unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BASEBOARD RADIATOR INSTALLATION

A. Install units level and plumb.

B. Install baseboard radiators according to Guide 2000 - Residential Hydronic Heating.

C. Install enclosure continuously around corners, using outside and inside corner fittings.

D. Join sections with splice plates and filler pieces to provide continuous enclosure.

E. Install access doors for access to valves.

F. Install enclosure continuously from wall to wall.

G. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

H. Install valves within reach of access door provided in enclosure.

I. Install air-seal gasket between wall and recessing flanges or front cover of fully recessed unit.

J. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water units and components to piping according to Division 23 Section "Hydronic Piping."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Install control valves as required by Division 23 Section "Instrumentation and Control for HVAC."

D. Install piping adjacent to convection heating units to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

A. 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. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

3.5 WARRANTY

A. 5 years from substantial completion.

END OF SECTION 238233

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SECTION 238238 - ELECTRIC HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.2 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 details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 WARRANTY

A. Provide five-year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Qmark, Ouellet, Indeeco

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

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. All heaters to be cETLus listed.

2.3 CABINET

A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

C. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2.4 COIL

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

2.5 FAN AND MOTOR

A. Fan: Aluminum propeller directly connected to motor.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Controls: Unit-mounted thermostat or Low-voltage relay with transformer kit.

B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.7 CAPACITIES AND CHARACTERISTICS

1. See plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. 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.

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."

END OF SECTION 238239

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SECTION 238239 - 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:

1. Cabinet unit heaters with centrifugal fans and hot-water coils.
2. Propeller unit heaters with hot-water coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For cabinet unit heaters 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

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. Cabinet Unit Heater Filters: Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trane.
2. Rittling
3. Vulcan

B. Motors to be electronically commutated.

C. Provide MERV 8 filters

D. For non-ducted air inlets and outlets: provide linear bar grille

2.2 PROPELLER UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Rittling.
2. Trane.
3. Vulcan

B. Comply with UL 2021.

C. Comply with UL 823.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

G. Discharge Louver: Adjustable fin diffuser.

H. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.

I. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, 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 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

K. Control Devices:

1. Wall-mounting thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

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 Division 07 Section "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install propeller unit heaters level and plumb.

D. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Install wall-mounting 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.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Comply with safety requirements in UL 1995.

D. Unless otherwise indicated, install union and ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 WARRANTY

A. 2 years from substantial completion.

END OF SECTION 238239

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SECTION 260100 - GENERAL ELECTRICAL MATERIALS AND METHODS

26-1 GENERAL INSTRUCTIONS.

1. All requirements under Division one and the general supplementary conditions of these specifications shall be a part of this section. Each contractor shall be responsible for becoming thoroughly familiar with all its contents as to requirements which affect this division or section. The work required under this section spans all drawing divisions (Architectural, Civil, Mechanical, Fire Protection, Plumbing, et al) and includes all material, tools, equipment, appliances, hoisting, excavation, backfill, restoration, and labor required to complete all the work as required by the drawings and specifications or reasonably inferred to be necessary to facilitate each system functioning as indicated by the design and the equipment specified. Total installation is to conform to all codes and standards affecting the work. Coordinate with the owner. The contractor shall do all alterations and rework required for the proper integration of new with existing areas; any areas outside the work boundary affected by construction activities must be returned to pre-construction condition immediately following the work.

a. Generate and complete all forms, applications, inspections, and the like necessary for the acquisition of energy incentives available from the utility and government regulating entities.

b. Public ways and access drives shall be kept free of mud or other debris deposited by any equipment associated with the work. Muddy equipment must be pressure cleaned each time prior to exiting the site. Contractor is completely responsible for his own street cleaning.

2. Inspection of site.

The contractor shall personally inspect the site of the proposed work and become fully informed as to the conditions under which the work is to be done. Use field measurements and observations to prepare bid. Commencement of work infers acceptance of all existing conditions.

3. Material and workmanship.

All material and apparatus shall be new and in first class condition. All material and apparatus shall have markings or nameplate identifying the manufacturer and providing sufficient reference to establish quality, size, capacity, and approved listing. All workmanship shall comply with published industry standards, including NECA/NEIS, NECA-1-2010, and the American Electrician's Handbook, latest edition. OSHA rules, regulations, and requirements are a part of this contract. Electrical contractor shall follow them as well as state and local requirements for the safety of workers on the job and passers-by.

4. Coordination.

The contractor shall coordinate all work with other contractors and subcontractors so that various components of the electrical system will be installed at the proper time, will fit the available space, and will allow proper service access to all equipment. The contractor shall refer to architectural, structural, and mechanical drawings and relevant equipment drawings to determine the extent of clear spaces. The contractor shall make all offsets required to clear equipment, beams, and other structural members, and to facilitate concealing conduit in the manner anticipated in the design. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finish actually installed.

5. Dimensions and layout.

The drawings are schematic in nature and not intended to show every accessory or component necessary for a complete installation. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all contract documents. The contractor shall be held responsible for errors which could have been avoided by proper checking and inspection.

6. Interior Minor Electrical Demolition as applicable.
    a. The Owner determines which sections (if any) of the existing Fire Alarm and/or Fire Suppression systems shall remain in service during demolition. Areas left otherwise unprotected shall be supervised by either a live fire watch or temporary detectors.
    b. The Owner determines which sections (if any) of any existing telephone or or other structured cabling or low voltage system shall remain in service or protected during demolition and new work.
    c. The drawings are intended to indicate the scope of new work required and do not necessarily indicate any existing boxes, conduit, or wire that must be removed to accommodate it. THE CONTRACTOR SHALL VISIT THE SITE PRIOR TO SUBMITTING A BID AND VERIFY EXISTING CONDITIONS.
    d. Where walls, ceilings, structures, etc., are indicated as being removed on general drawings, the Contractor shall be responsible for the removal of all electrical equipment, devices, fixtures, raceways, wiring, systems, etc., from the removed area.
    e. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.
    f. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area.
    g. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and electrical service to avoid conflicts.
    h. Bid submittal shall mean the Contractor has visited the project site and has verified existing conditions and scope of work.
    i. Maintain existing Fire Alarm and/or Fire Suppression Systems as required by Owner.
        a. Temporary disabling of an in-service system requires that the Owner be notified 24 hours in advance.
        b. Detectors left in place must be protected from dirt and damage and returned to full operating compliant condition at the conclusion of the work.
    j. Existing Electrical Service: Maintain existing system in service; schedule necessary outages with Owner within one month of commencement of work.
    k. Disconnect electrical systems in walls, floors, structures, and ceilings scheduled for removal.
    l. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.
    m. The E.C. is responsible for all temporary lighting and power in all work areas per Division 1. Comply with NECA 200-2010.
    n. Remove, relocate, and extend existing installations to accommodate new construction.
    o. Remove abandoned wiring and raceway to source of supply.
    p. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

q. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is removed. Provide blank cover for abandoned outlets that are not removed. Patch openings created from removal of devices to match surrounding finishes.
r. Disconnect and remove abandoned panel-boards and distribution equipment.
s. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
t. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories. Provide for proper recycling or disposal of existing lamps and ballasts removed from the site in accordance with EPA and State of Illinois regulations.
u. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.
v. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
w. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
x. HID and fluorescent lamps, determined by the Toxicity Characteristic Leachate procedure (TCLP), to be hazardous waste shall be disposed of in a permitted hazardous waste disposal facility or by a permitted lamp recycler.
y. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
z. Floor slabs may be post-tensioned (E.C. to verify prior to commencement of work). When applicable, X-ray all penetrations prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.
aa. Floor slabs may contain conduit systems. The Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes X-ray or similar non-destructive means.
bb. The Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.
cc. Distribution and Branch Panelboards: Clean exposed surfaces and check tightness of electrical connections. Lubricate where required. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

6. Ordinances and codes.

Contractor's performance, workmanship, and materials shall comply with state and local building codes, NFPA codes as referenced therein, local amendments, industry standards (NEMA, NECA, etc.), and/or all other applicable codes and ordinances. See Sheet T1.0 for a list of applicable standards. Contractor shall comply with rules and regulations of the public utilities and municipal departments affected as applicable. Obtain and pay all permits, unless stipulated otherwise in other Division 1. Contractor shall be held responsible for any violations of law. Contractor shall maintain all necessary signal lights and guards for the safety of the public. See drawings for additional information.

Comply with 23 Illinois Administration Code Section 180 (or as superseded by later documents), including but not limited to the 2015 International Building Code and its subcodes, 2018 International Energy Conservation Code, and 2014 National Electrical Code as reference therein; comply with other codes and standards referenced elsewhere in the document set.

7. Substitutions:

a. The specification provides that the base bid of all contractors shall include the products specifically named, the contractor being permitted to submit in the form of alternates with his proposal products of any other manufacturers for similar use, provided the difference in cost, if any, is specified in each case. The terms "approved" or "approved equal" shall mean approved by the architect as an acceptable alternate bid. The term "equal" or "available manufacturers" shall mean products similar or identical in appearance, function, or specification to a basis-of-design product and manufacturered to directly compete with, replace, or supersede the specified product. The architect shall have final authority as to whether a substitution is an acceptable replacement to the specified item. The proposed substitution may also be rejected for aesthetic reasons. In the event of rejection, the specified item shall be furnished.

b. Value Substitutions: The contractor is completely responsible for all substitutions, changes, or deletions of work or products proposed to and accepted by the owner or architect in lieu of specified and shall hold the owner and architect harmless for any liabilities created by such changes. As much as is possible, such proposals for change shall indicate how the specified design goals, the work of other trades, and the construction schedule are expected to be impacted. The contractor is responsible for research of all codes and standards applicable to the proposed change, professional design services necessary to implement the change, re-submittals for state and municipal permits and additional fees invoked by the change, and notification of and coordination with other trades impacted by the change. After acceptance of a change proposal by the owner or architect, the contractor shall notify them within ten calendar days of any unexpected discovered conditions that may impact the work. After this period, the contractor shall not be excused from any liabilities created by their own proposed change(s) and shall be responsible for any discovered costs incurred by anyone due to the change(s).

8. Adjusting, aligning, and testing.
All electrical equipment on this project furnished under this division and all electrical equipment furnished by others and installed by the electrical contractor shall be adjusted, aligned, and tested for proper operation by the electrical contractor. Complete wiring systems shall be free from faults. All motors shall be verified for proper rotation and protection. The contractor shall maintain on the project premises the following at all times: a true rms reading voltmeter and ammeter, a megger insulation resistance tester. The contractor shall provide test data readings as requested or as required.

9. Operation and maintenance instructions.
Submit to the architect three copies, unless indicated otherwise in Division 1, of maintenance and operation instruction manuals appropriately bound into manual form including record copies of the following, revised if necessary, to show system and equipment as actually installed: manufacturer catalog sheets, wiring diagrams, maintenance instructions, operating instructions, parts lists. Contractor shall also provide adequate owner's staff training at the termination of the work. Electronic submittals are acceptable with the approval of the owner and/or architect.

11. Start up of systems and Commissioning.
Prior to startup of the electrical systems, the contractor shall check all components and devices, lubricate items accordingly, and tighten all screwed and bolted connections. Adjust taps on each transformer for

rated secondary voltage. Check and record building's service entrance voltage, grounding conditions, ground resistance, and proper phasing and rotation. Balance all single-phase loads at each panelboard; redistribute branch circuit connections until balance is achieved. Replace all burned-out lamps. Touch-up paint all marred equipment finishes. After all systems have been inspected and adjusted, confirm all operating features required by the drawings and specifications and make final adjustments as necessary.

Commissioning.
All electrical systems shall be commissioned by the contractor in accordance with applicable section of IECC 2018 and with NECA 90-2015 (latest iteration), Recommended Practice for Commissioning Building Electrical Systems (ANSI), available from NECA Order Desk at (301)215-4504, orderdesk@necanet.org, or www.neca-neis.org/catalog. Documentation shall be included in the close-out documents.

12. Guarantee.
The contractor shall guarantee against defective workmanship and material for a period of two years from date of substantial completion. Guarantee shall include material to be replaced and all labor required. Manufacturers' standard guarantees and warranties of longer duration shall be in force.

26-2 ELECTRICAL INSTALLATION. SEE DIVISION 260543 FOR UNDERGROUND DUCTS

1. Cleaning.
Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The contractor shall cooperate in maintaining reasonably clean premises at all times. Immediately prior to final inspection, the contractor shall make a final cleanup of dirt and refuse resulting from his work. The contractor shall clean all material and equipment installed under the electrical contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from all surfaces. Damaged finishes shall be touched up and restored to their original condition.

2. Cutting and patching.
This contractor shall do all cutting of walls, floors, ceiling etc. as required to install work under this section. The contractor shall obtain permission of the architect or owner before doing any cutting or coring. All holes shall be cut as small as possible. Contractor shall patch walls, floors, etc. as required by work under this section. All patching/repairs shall match the original finish and construction and be approved by the architect.

3. Rough-in.
Coordinate without delay all roughing-in with general construction. All conduit rough-in shall be concealed except in unfinished areas and where otherwise shown.

4. Conduit.
All conduits shall be run concealed except where otherwise noted (see Section 6 below). All conduits associated with the electrical service or run underground, exposed to weather, or other hazardous conditions shall be rigid. All other conduit may be EMT where approved by local code. Install PVC exposed in corrosive areas such as pools and pool pump rooms and chemical rooms as permitted. PVC in or under slab shall be an acceptable substitute when allowed by local code and where it is changed to rigid metal conduit at least 10'-0" before it exits the slab. Minimum conduit size for power applications is 1/2" trade size; minimum conduit size for low voltage applications is 3/4" trade size; minimum size embedded conduit is 3/4" trade size; maximum size embedded in toppings is 1" trade size. Use flexible metal conduit or liquidtite flexible metal conduit for connections to vibrating equipment, transformer, lighting troffers, and the like. All conduits shall be provided with an insulated equipment grounding conductor.

5. Concealed flexible wiring methods: Type MC cable shall be an acceptable wiring method where installed concealed per manufacturer's instructions and compliant with the NEC. Type MC shall be equal to Southwire brand Armorlite, constructed with soft-drawn copper, Type THHN/THWN minimum #12 600-volt conductors rated 90^0C, and a green insulated grounding conductor. Type Alflex not acceptable. The conductors shall be cabled together with a binder tape bearing the print legend wrapped around the assembly and covered with aluminum interlocking armor. The product shall meet or exceed UL 83, UL 1569, UL 1685, Fed. Spec. A-A56544, FT4/IEEE 1202 (70,000 Btu/hr) Vertical Cable Tray Flame Test, NEC, Listed for use in UL 1, 2, 3-hour Through Penetration Firestop Systems, and REACH/RoHS-2. Fittings shall be manufactured specifically for the purpose; equal to Steel City XC-7xx and XC-130 series. Die cast zinc two-screw universal clamp conenctors, such as Steel City XC-280, are not acceptable. Comply with NACMA (NECA/NACMA 120) installation procedures.

6. Conduit installation.
Comply with NECA 101-2013.
All wiring shall be run in conduit, except that power limited cable not associated with emergency (voice) communication of fire alarm systems may be installed concealed using compliant open wiring methods. Conduit shall be installed concealed and properly supported above suspended ceilings, in wall cavities, or below floors wherever possible or unless noted otherwise on the plans. Notify the architect where concealment is not possible and provide surface metallic raceway manufactured for the purpose and approved by the Architect. Run parallel or at ninety degrees to building lines. Conduit shall be installed to requirements of structure and to requirements of all other work on the project. Conduit shall be installed to clear all openings, depressions, pipes, ducts, reinforcing steel, etc. Conduits shall be installed continuous between connections with a minimum possible number of bends and not more than four 90-degree bends between boxes. Bends shall be smooth and even and shall be made without flattening conduit or flaking enamel or galvanizing. Long radius elbows shall be used where necessary or specified. No short radius bends. Conduits shall be securely fastened in place with approved straps, hangers, and steel supports as required. Groups of horizontal conduit runs shall be clamped to steel channels and suspended from inserts or anchors spaced not more than 10 feet apart. Vertical feeder conduits shall be securely clamped to structural steel members attached to structure. Cable clamps shall be installed for support of vertical feeders where required. Conduit supports shall be added within 12" at one end of all bends. Conduit shall not be supported from suspended ceiling components. Conduit ends shall be reamed before installation and all conduits shall be thoroughly cleaned before installation and kept clean after installation. Openings in boxes shall be plugged or covered as required to keep conduit clean during construction and all conduit shall be fished clear of obstructions before the pulling of wires. All conduits shall be of ample size for pulling of wire and shall not be smaller than code requirements. All electrical work shall be protected against damage during construction. Any work damaged or moved out of line after roughing-in shall be repaired to meet engineer's approval without additional cost to the owner. Conduit termination at panelboards, switchboards, motor control equipment and junction boxes shall be aligned and installed true and plumb. Install approved expansion fittings where conduit passes through expansion joints. Install a pull wire in each empty conduit which is left by the contractor for installation of wires or cables by others. Make all joints and connections in a manner which will insure mechanical strength and electrical continuity. Thru-wiring of light fixtures is not permitted except in fluorescent channels. Conduit seals shall be installed on all conduits passing from non-conditioned to conditioned spaces and in all conduit penetrations of freezer and cooler walls. Furnish and install the necessary junction boxes, couplings, supports, adapters, etc., to form a complete assembly.
Conduits shall be identified for voltage per ANSI A13.1.

7. Conduit sizes indicated on the plan are intended to represent the minimum size required to accommodate the specified conductors. The contractor shall select larger trade sizes and longer radius

bends where necessary to alleviate jamming and excessive pulling tension due to distance, number of bends, and the like.

8. Bushings and locknuts.
Where threaded conduits enter boxes, they shall be rigidly clamped to the box by interior and exterior locknuts or approved fittings, and the conduit end capped with suitable bushing. Pre-insulated steel no-thread fittings are acceptable. EMT fittings shall be listed and approved for the purpose, steel or die-cast type, set screw type where permitted, compression type in plenum spaces. The fitting shall be rigidly fixed to the box with locknut and fitting shoulder; fittings may be preinsulated-type where bushings are otherwise required. Conduit fittings that connect to the box via a spring held pressure clip (i.e., Arlington Snap-tite, et al) are not acceptable for any raceway terminations; conduit fittings that fasten to the box with locknuts but grip the conduit via spring held pressure clips or cams (i.e., Garvin SICN series, et al) are acceptable. Two-piece connectors are acceptable.

9. Wire.
   a) All building wire shall have copper conductors, with U.L. label and 600-volt insulation. All wire shall be run in conduit. All exterior wire wire shall be type XHHW, or XHHW-2 where indicated. All interior wire shall be type THHN/THWN. All wire #10 and smaller shall be solid or stranded as necessary; wire larger than #10 shall be stranded. Wire within lighting channels shall be type THHN. All branch circuit wire shall be not smaller than #12 awg wire. If no wire size is indicated on the drawings for a branch circuit, provide #12 awg wire and 20a circuit breaker. Non-power limited control wire shall have 600-v insulation and be the proper type, size, construction, and number as required by the equipment manufacturer.
   b) All wiring shall be installed in approved raceway and enclosures, except where low voltage wire is allowed to be installed via open methods. Support all wire and cables in vertical installations as required by code by installing cable supports or plug-type conduit riser supports. All wire and cable in conduit shall be continuous without taps or splices. All splices or taps shall occur in approved boxes and enclosures, shall be kept to the minimum required, and shall be made with approved solderless connections. All splices, taps, and joints shall be insulated as required by code. All materials used to terminate, splice, or tap conductors shall be designed for the purpose, properly sized, U.L. listed for the specific application and conductors involved, and installed in strict accordance with the manufacturer's specifications using specified tools. Where wire is indicated to be installed, but the connection is indicated "future" or "by others", contractor shall leave a minimum of 3 feet of slack at the box, taping the ends of the conductors.
   c) Feeder splices shall be made with appropriately sized pre-insulated multi-tap connectors such as NSi Polaris series; do not use split bolts.
   d) Branch circuit splices and taps shall be made with expanding spring type wire connectors (i.e. Buchanan B-Cap type, Ideal Wing type, et al). Fixed, square wire spring type (i.e. Ideal 76B, et al) are not acceptable unless provided by the manufacturer for final equipment connections. Push-in wire connectors are not acceptable except when provided as an OEM accessory (eg, luminaire disconnect).
   e) All terminal blocks and wire terminals for control wiring shall be properly numbered for identification with listed vinyl stick-on markers or equivalent. Identify fire alarm wiring per NEC 760.
   f) Wiring to low voltage wiring systems shall comply with NEC Section 411 and other sections referenced therein.
   g) Use consistent identification designations throughout Project. Install identifying devices before installing ceilings and similar concealment.

10. Conductors shall have insulation of the proper color to match NEC color code table and as indicated below. In larger wire sizes where properly colored insulations are not available, the contractor shall

install listed vinyl plastic identification tape of the appropriate color at all termination points, junction boxes, and pull boxes:

i. 120/208-volt system: phase A, black; phase B, red; phase C, blue; neutral, white; ground, green.
ii. 277/480-volt system: phase A, brown; phase B, orange; phase C, yellow; neutral, gray; ground, green with white stripe.

11. Cable Ties.
    1. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
        a. Minimum Width: 3/16 inch (5 mm).
        b. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
        c. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
        d. Color: Black except where used for color-coding.
    2. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
        a. Minimum Width: 3/16 inch (5 mm).
        b. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
        c. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
        d. Color: Black.
    3. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.
        a. Minimum Width: 3/16 inch (5 mm).
        b. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
        c. UL 94 Flame Rating: 94V-0.
        d. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
        e. Color: Black

11. Junction boxes.

Provide junction boxes, pull boxes, cabinets, and wireways wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the drawings. Size as required for the specific function or as required by the NEC, whichever is more restrictive. Junction boxes shall be minimum 4" square or larger, galvanized, with matching galvanized cover. Larger Nema 1 boxes may have a compliant painted finish.

12. Outlet boxes.

All outlet boxes including switch, receptacle, and outlets, shall be galvanized, manufactured for the purpose, and sized as required per NEC. All boxes shall be set in walls, columns, floors, or ceilings in finished areas so as to be flush with the finished surface and be accurately set and rigidly secured in position. When using spring steel or similar clips to mount a box to a stud, also provide matching far side box supports. Provide plaster rings, extension rings, and masonry rings as required for flush mounting.

13. Outlet locations.

Outlets are only approximately located on the plans, and great care must be used in the actual location by consulting the various large-scale detailed drawings and equipment cuts, or by securing definite locations from the architect. The height of outlets shall be installed according to the device height detail provided

on the plans, or as otherwise required by locally accepted accessibility rules, or to accommodate casework heights.

14. Wiring devices (as applicable).
    a) Comply with NECA 130-2010, Standard for Installing and Maintaining Wiring Devices.
    b) Furnish and install outlets and switches where shown or required. Minor changes relative to the location of electrical equipment may be made by this contractor to comply with the structural and building requirements as determined in the course of construction. All outlets and switches must be of the same manufacturer and not mixed on the project. Color of toggles and receptacles shall be brown in wood surfaces and white for painted surfaces. All switches shall be minimum 20-amp commercial grade equal to Hubbell CS120 series. All receptacles shall be minimum 20-amp commercial grade equal to the Hubbell CRxx family; provide GFCI protection, AFCI protection, and/or tamper resistant devices wherever required by code or where indicated. Other devices shown but not specified above shall be of the same construction quality as defined above. Receptacles shall be oriented vertically with the ground prong up or horizontally with the neutral up to match a building standard or where a specific orientation is required by local code.
    c) All branch circuit conductors shall be connected to receptacles and switches by means of the screw terminal(s) that are so designed and/or manufactured with the said device. The insertion and/or installation of any conductor into the screw-less terminals of any electrical device shall not be the accepted method of connection and/or installation of the conductor and will not be permitted.
    d) All branch circuit conductors shall be made up and/or spliced in such a manner as to provide a single “pigtail” conductor to be connected and/or installed to any electrical device screw terminal.
    e) The continuity of any branch circuit conductor or neutral shall not be dependent upon the device connection.

15. Cover plates.

All commercial switch, receptacle, data, and blank plates shall be brushed stainless steel. Contractor shall verify the desired material with the architect before installation. Device plates in unfinished spaces shall be compliant stamped steel ("garvin") type manufactured for the purpose; trim covers in damp locations shall be gasketed weatherproof as indicated below. Group switches serving the same area under multi-gang trim plates. Plates shall be set plumb, parallel, and flush with the wall finish.

16. Weatherproof covers.

Wet location cover plates shall be “in use” die cast A360 aluminum type with neoprene gasketing and designed to not rely on the device for the integrity of its attachment to the box. Product shall have clear UL markings, a variable range of cover depths, locking cover tab; such as Red Dot CK series. Devices shall be listed weather-resistant type.

17. Firestopping.

This contractor shall seal all penetrations through fire rated floor and wall assembles in accordance with the NFPA codes and UL wall construction types. The sealing system shall be capable of passing a three-hour test, per ASTM E-814 (UL 1479). Penetration sealing system shall be acceptable to the AHJ (E.C. to verify) and installed per the manufacturers recommendations. Use silicon type where accumulation of water is an issue. PVC conduit may not be used as a sleeve through fire rated partitions for any reason.

18. Roof penetrations.

Provide gasketed roof portals (equal to Portals Plus) listed for use with the roofing material as required. All roof penetrations shall be leaktight at the termination of the work.

19. Access doors.

Provide access doors in ceilings, walls, etc. where indicated or required for access to or to maintain work installed under this section. Provide fire rated type in fire-resistance rated elements, gasketed type in showers and locker rooms and similar areas. Milcor or equal.

20. Equipment identification.
This contractor shall furnish and install equipment identification nameplates on all panelboards, safety switches, starters, dimmers, drives, and the like, and wherever mandated by code. Nameplates shall be engraved phenolic plastic and shall be firmly attached to the equipment. Nameplates shall clearly identify each item, its voltage, and what it controls.

21. Plenum spaces.
All equipment and wiring methods in ceiling cavities used as environmental air plenums shall be approved for the application and conform to the NEC.

22. Seismic Bracing as applicable.
Verify seismic rating of the structure with the structural plans. Provide approved engineered seismic bracing or anchors where required for lay-in fixtures, cable trays, conduits, enclosures, and the like as required by code.

26-3. ELECTRICAL SERVICE AND GROUNDING.

1. Connection to serving utilities (as applicable).
Contractor shall provide proper termination, metering provisions, grounding, etc., for electrical services for connection by the serving utility in strict compliance with the requirements of all codes having jurisdiction and the rules of the serving utility involved. All service terminations and connection points shall be verified in the field by this contractor, and he shall work in conjunction with the utility involved in the installation of all service equipment and cable. This contractor shall provide all conduit, cable, accessories, etc. specified by the utility. The contractor shall notify the utility company involved within two weeks after notice to proceed, of all required information necessary in order for the utility to supply the project without delay.

2. Grounding.
Furnish and install a complete bonded grounding electrode system complying with the latest applicable edition of the National Electrical Code. The electrical service, all transformers, raceways, frames, and the like shall be effectively grounded by this contractor in a thorough and efficient manner in conformance with the NEC. All raceways shall contain an equipment grounding conductor; raceways shall not be relied upon as an effective ground return path. Voltage drop shall not exceed 2%.

3. Unless superseded by locally accepted codes and standards, grounding and bonding shall be performed in accordance with NECA 331-2009 (or latest applicable iteration), Standard for Installing Bonding and Service Entrance Grounding.

26-4. DISTRIBUTION AND CONTROL EQUIPMENT.

1. Power distribution panels.
Circuit breaker Types: Panels installed as service entrance equipment shall be permanently marked to identify it as suitable for use as service entrance equipment with number and size breakers as scheduled. Panels shall have copper bus and be braced for available inrush (E.C. to verify with utility). Branch breakers shall have an engraved phenolic nameplate for circuit identification. Panels shall have a hinged, lockable door to cover the circuit breaker handles. A typewritten circuit directory shall be installed on the

inside face of the door. The panelboard shall be capable of accepting any frame size listed for the bussing application regardless of its position in the panelboard; a breaker frame on one side of the bus shall not dictate frame size of the opposing breaker: Square D I-Line type or equal by G.E. EntellEon Series.

2. Panelboards.
Comply with NECA 407-2015, Recommended Practice for Installing and Maintaining Panelboards.
New panelboards shall be equal to Square D NQ or NF series as applicable, unless necessary to match an existing building standard. The panelboards shall be complete with thermal magnetic plastic case circuit breakers of the bolt-on type assembled in a finished cabinet. All 2 and 3-pole breakers shall have common trip. Breakers used as switches shall be marked "SWD." and approved for the purpose. Breakers serving hvac equipment shall be rated HACR type. Provide copper bussed panels braced for available inrush (E.C. to verify). Load Centers with plug-in circuit breakers shall be installed only where indicated and shall be acceptable to the local AHJ. Panelboard or load center construction shall be of NEMA design suitable for the environment into which it is installed.

3. Existing panelboards.
New circuit breakers required to be installed in existing panelboards or load centers shall be of the same manufacturer, type, and AIC rating as the existing circuit breakers. The new breaker shall be listed for the application without field modification. Provide new typewritten panel directories showing assignments of all circuits affected by the work.

4. Disconnect switches.
Contractor shall furnish and install fused or non-fused safety switches as noted or required. Provide NEMA heavy duty externally operable type unless noted otherwise. Fuse holders shall have Class R rejection feature. Construction shall be of a NEMA design suitable for the environment into which it is installed.
In kitchen applications, provide NEMA 4X compact non-metallic types equal to Bussman EFJ/ENF series, Hubbell HBLDS3 series, or similar.
Manually test all safety switches for proper operation prior to energizing.

5. Fuses.
Fuses shall be of the size and type required. Fuses larger than 600-amp shall be Class L current limiting type. Fuses for motors shall be class RK5 time-delay type. All fuses shall have a minimum 100kaic rating. When applicable, comply with NECA 700-2016, Standard for Installing Overcurrent Protection to Achieve Selective Coordination.

6. Dry-type transformers (where applicable).
Dry-type transformers shall be 150-degree temp rise above 40-degree ambient rated. Insulating materials shall exceed NEMA ST20 standards and be rated for 220-degree c UL component recognized insulation system. Phase, voltage, and size shall be as noted on the drawings. Sound level shall not exceed 45 db per NEMA standards. Units larger than 24kva shall have four 2.5% full capacity primary taps. Units up to 225 kva shall be mounted on vibration isolation pads with a .25" static deflection. Conduit connections to transformers shall be made with flexible metallic conduit with at least 6" of slack in all directions. Transformer enclosures shall be ventilated and be fabricated of heavy gauge sheet steel construction. Maintain minimum NEC clearances and manufacturer required clearances.

7. For new buildings with emergency power sources and utility services in excess of 1200-amps, engage the distribution equipment manufacturer's engineering services to provide a selective coordination fault-current study of the electrical distribution system from normal and alternate power sources using a

computer software program to plot and diagram time-current-characteristic curves and report recommended settings and ratings of all overcurrent protective devices. The study shall include arcing faults, simultaneous faults, explicit negative sequence, and mutual coupling in zero sequence as deemed necessary by the engineer.

8. All commercial buildings, industrial buildings, and residential buildings where vaults, transformers, electrical equipment, and sub-feed service equipment are located and rated at 800-amps or more, or transformers rated at more than 200 kVA, shall be grouped and installed in an approved electrical closet or room approved for the use, and provided with power ventilation. The space shall be designed to accommodate the required equipment working space.

26-5. INTERIOR LIGHT FIXTURES, LAMPS, BALLASTS..

1. When directed to provide new lighting in areas the E.C. shall be responsible for all the work as described, indicated, or directed. See lighting fixture schedule for specified fixtures for the project. See project alternates for modified scopes.

2. Test Emergency Lighting affected by the work: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal. Aim unit equipment to meet manufacturer's and AHJ's egress compliance requirements. Luminaires will be considered defective if they do not pass the operational tests and inspections.

3. Reprogram existing wireless-controlled lighting fixtures per manufacturer instructions. Contact manufacturer representative for recommissioning any new and existing lighting controls for modified spaces.

26-6. EXTERIOR LIGHTING See plans for building specific requirements.

26-7. MISCELLANEOUS ELECTRICAL

1. Wiring of applicable mechanical equipment.
Furnish and install all power wiring and all line voltage control or interlock wiring of all units, pumps, fans, water heaters, air handlers, kitchen equipment, and othe equipment and appliances as specified or as scheduled elsewhere in the documents or otherwise indicated or inferred by the body of drawings. Connect per manufacturer's wiring diagrams to be furnished with equipment. Furnish and install all loose disconnects and starters needed or required (see mechanical schedules). After installation the contractor shall verify that each motor load has the correct phase rotation and permanently indicate the rotation on the equipment or it's controller or disconnect. This contractor shall verify the actual wire sizing amps for mechanical equipment from the equipment nameplate; electrical installation shall be based on actual required amperages, which may vary from the wire and equipment sizes shown on the drawings. Properly sized electrical wiring and equipment shall be furnished without extra cost to the contract. The contractor shall notify the architect of all changes to be made in the electrical installation due to equipment variances so that the impact on the feeders, panels, fuses, and breaker sizes can be checked prior to the installation. This contractor shall be responsible for coordinating with the mechanical, refrigeration, and plumbing contractors to verify the actual wire sizing amps and correct sizes of all overload heaters and the like for all equipment.

2. Temperature control as applicable.
Temperature control wiring is specified under Division 23. When indicated in those specifications, include the control wiring in the electrical work.

3. Telecommunications systems.
Telecommunications cabling is not part of this contract except as is necessary to repair or relocate existing wiring to accommodate new mechanical work. All network cable shall be Cat6 cable 350mHz tested cable installed per the current iteration of TIA/EIA 568 series standards and installed and tested per the latest itereation of NECA/BICSI 568. Multi-mode interior fiber optic cable shall be 50-micron multimode OM3 type. Contractor shall provide all outlet boxes, stubs, sleeves, backboards, wiring, patch panels, jacks, trim plates, identification, testing, mapping, and the like as required to accommodate the work indicated on the plans and as needed to support systems specified elsewhere.

4. Time switches.
Provide electronic time switches with number and type of contacts, sequence, and voltage necessary to accommodate the work. Time switches for exterior lighting control shall be electronic digital astronomic type with manual bypass switch, suitable NEMA enclosure, and battery backup. Provide photocells, contactors, relays, or other controls as required or as indicated. Master lighting controls shall be as specified on the plans; wallbox timers and other controls shall be as scheduled in the symbols legend.

5. Contactors.
Contactors for use with time switches for remote-controlled installations shall be NEMA types, electrically or mechanically held as applicable, and rated for the tungsten or ballast loads indicated. Contactors may be integrated into the respective controlling panelboards at contractor's option. Provide Owner’s standard nLight Relay Panel as indicated on the plan, field configurable, intended to migrate to future exterior wireless control systems when available.

6. Miscellaneous equipment and connections when applicable.
Provide line voltage interlock wiring of elevator shunt trip breaker and elevator recall as required, main breaker shunt trip wiring indicated, and interlock wiring of motors as directed on the mechanical and plumbing drawings. Provide final power hook-ups to furniture panels; extend telecom wiring into furniture panels and terminate at jacks mounted into modular outlets furnished by others. Where applicable, provide empty whips as required by other contractors when installing an empty conduit system for wiring by others.

7. Fire alarm when applicable.
To the extent necessary for the compliant execution of the specified work, the electrical contractor shall include all costs to design, furnish, and install all fire alarm system modifications or replacements compliant with the applicable International Fire Code (as locally accepted and amended), NFPA 72 and 70 by reference, and specific local practices as directed by the AHJ. Performing contractor must be credentialed per NFPA 72 standards, and locally bonded and insured for the work. Test for the continued satisfactory operational condition of any branch equipment or device affected by the work, protected in place, or salvaged for reuse; verify the system is restored to operational integrity in total. The contractor shall include all submittals and applications to the AHJ as locally required, and all equipment, devices, raceways, outlet boxes, special backboxs, stub-ups, sleeves, wiring, power hook-ups, and any other anecdotal materials and labor necessary to support the work. Coordinate with the owner and AHJ. Include reconsititution of existing fire alarm panel programming as needed, new programming as needed to support the new work, and conveyance of an electronic copy of the completed and tested program to the owner on USB storage device; re-progamming shall include all manufacturer program updates as

applicable. All NEW fire alarm raceways and outlet boxes shall be identified by a red finish. Job practices shall conform to NECA 305-2010, Standard for Fire Alarm Job Practices.

8. Submittals.
a. In addition to Division 1, as applicable, submit for review product data for fixtures, lamps, utility metering equipment, distribution equipment (panels, transformers, and the like), overcurrent devices, loose starters, contactors, and disconnects, branch devices and trim plates, any product substituted for specified, and any product accepted during a "value engineering" process. Provide quantities as stipulated in Division 1, but no fewer than six sets. Submit shop or assembly drawings prior to distribution to field personnel. Electronic submittals are acceptable if approved by the owner and/or architect.
b. Submittals shall be made at the outset of the project and subsequent product releases scheduled in a timely manner. The contractor shall act promptly to determine lead times and accommodate product availability. The contractor shall prepare a list of released products and delivery dates coordinated with the project construction schedule for distribution to the architect, owner, and project manager. Advise the architect immediately of specified or needed products being unavailable or discontinued; any project delays or additional costs resulting from the contractor's neglect of this responsibility shall be at the cost of the contractor.
c. Provide close-out documents as stipulated by Division 1, but not less than all owner's manuals, certifications, and warranties. PROVIDE COMPLETE DIMENSIONED AS-BUILT DRAWINGS. Include installation instructions shipped with equipment.

9. Attic stock (as applicable).
Provide at least three of each fuse type used.

10. Discretionary work. See Division 1 for discretionary work requirements. Where not specified in Division 1, provide the following:

a. Five duplex raintite 120-volt GFI weatherproof receptacles per building, each on a new separate 20-amp circuit and breaker from the nearest source within the building (maximum 150' lineal) to be installed as directed in the field by the owner, including compliant roof penetration if appliable.

END OF SECTION 260100